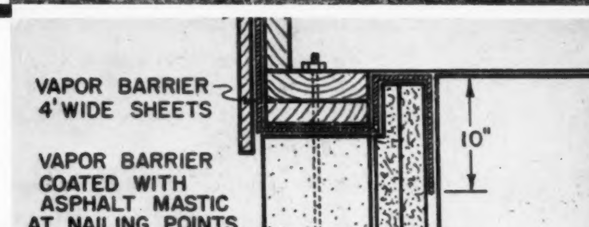
VAPOR BARRIER 4' WIDE SHEETS
VAPOR BARRIER COATED WITH ASPHALT MASTIC AT NAILING POINTS.
10"


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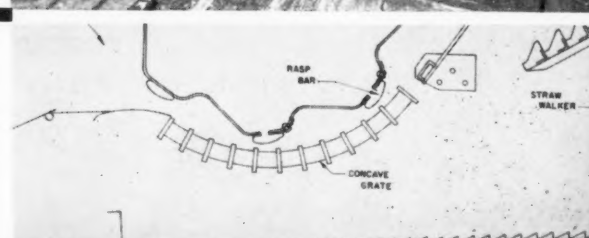
RASP BAR
STRAW WALKER
CONCAVE GRATE

CASE HISTORIES

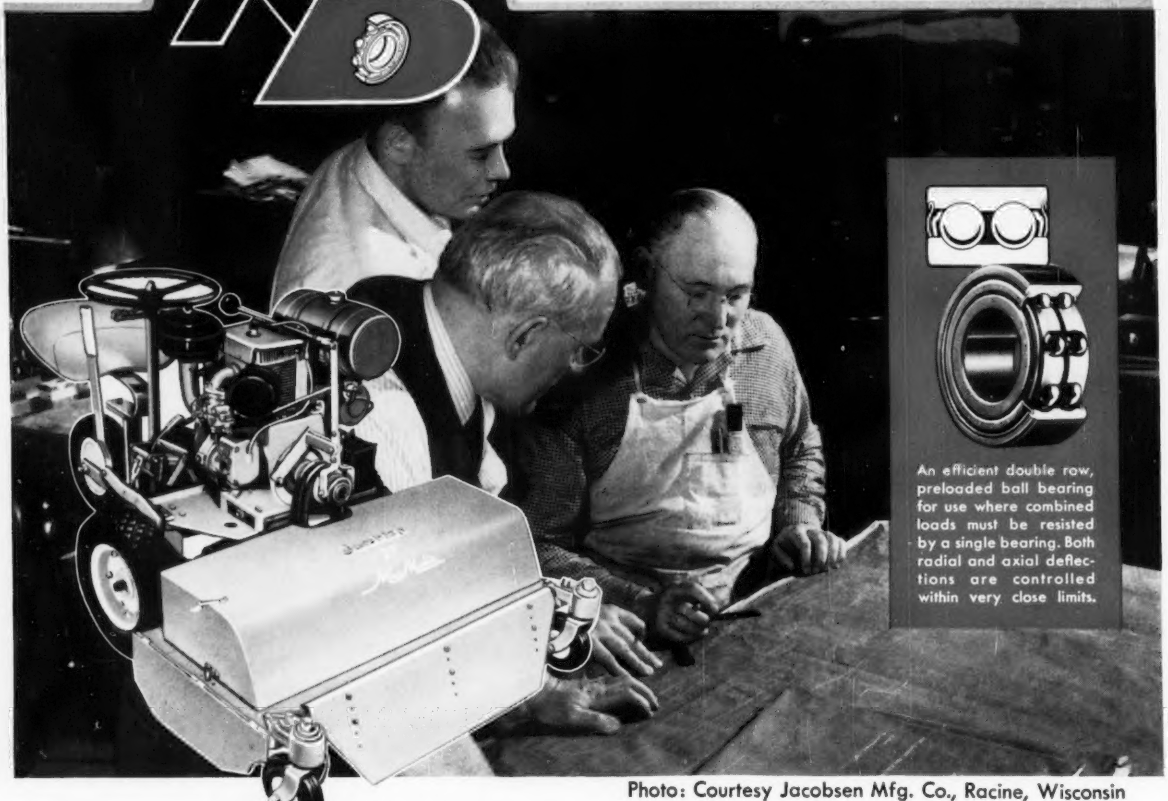

Photo: Courtesy Jacobsen Mfg. Co., Racine, Wisconsin

N/D Ball Bearing Design Helps Cut Power Mower Costs $4.29 Per Unit!

CUSTOMER PROBLEM:

Require bearing design that will help reduce production costs of power mower without affecting mower's high quality and performance.

SOLUTION:

N/D Sales Engineer, working with company engineers, recommended a new, more efficient cutter housing design utilizing three precision New Departure production double row ball bearings. These high capacity dual purpose bearings resist heavy radial and thrust loads in any combination. The conversion accounted for a parts and assembly-time cost savings of $4.29 per mower. In addition, the manufacturer is able to promise mower users years of trouble-free performance, while pricing more competitively at retail!

Perhaps there's a New Departure production ball bearing that will help lower costs and add new sales appeal to *your* product! Why not call on New Departure today? For more information write Department E-2.

Replacement ball bearings available through United Motors System and its Independent Bearing Distributors

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DIVISION OF GENERAL MOTORS, BRISTOL, CONN.

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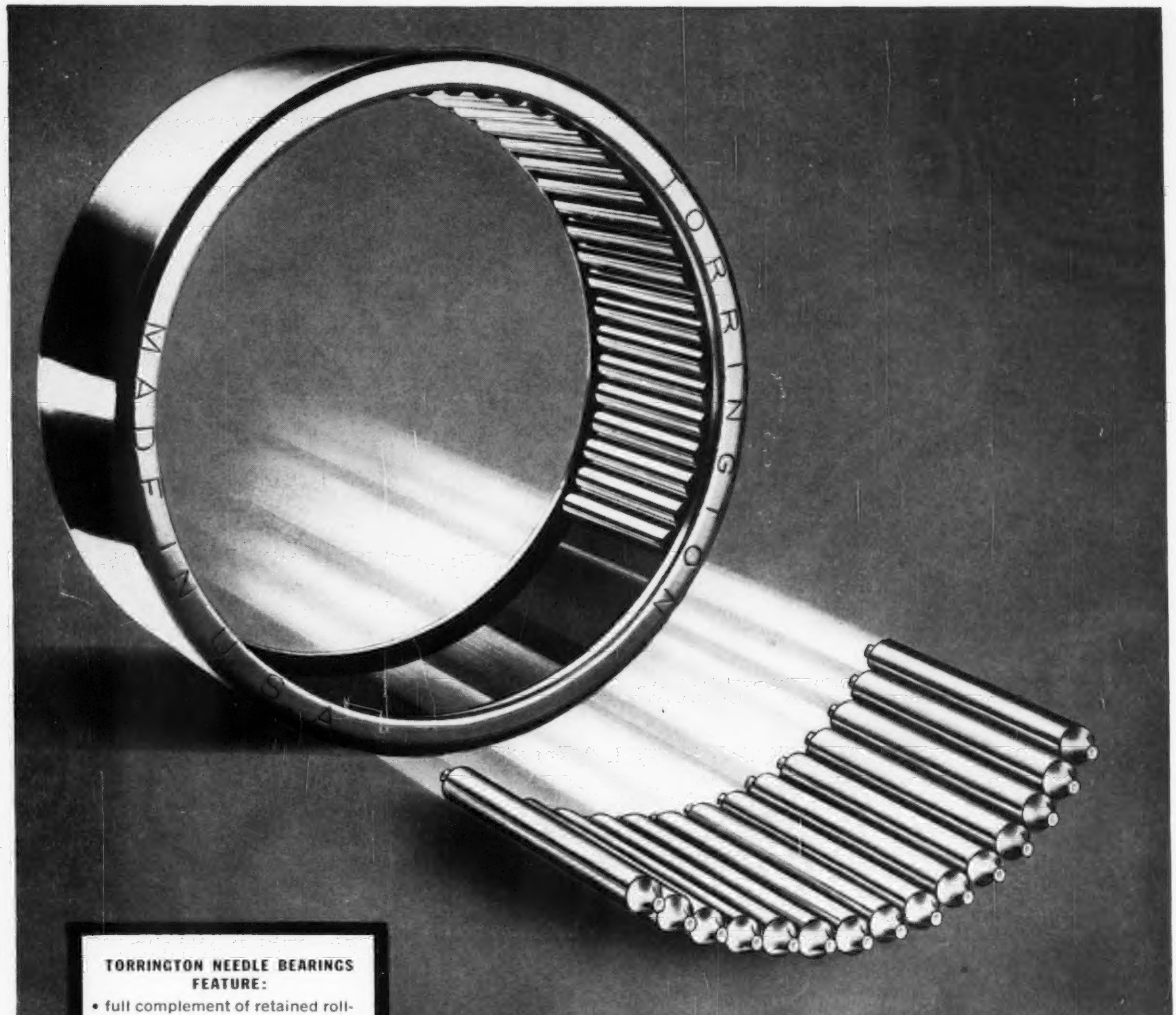

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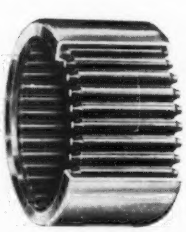

Here's Why Torrington Needle Bearings Provide Maximum Radial Load Capacity

The Torrington Needle Bearing's full complement of small diameter rollers provides the largest possible number of bearing contact lines in the load zone.

This feature gives Needle Bearings a higher radial load capacity than any other bearing of comparable size. Precision rollers ensure smooth anti-friction performance with low coefficient of starting and running friction, to match this unequalled capacity. Rollers are positively retained by the turned-in lips of the outer shell, permitting simple, economical installation and assembly.

Torrington experience spans twenty years in design and application of Needle Bearings to equipment of all types. This experience is at your disposal to help you secure the ultimate in performance built into every Torrington Needle Bearing. **The Torrington Company, Torrington, Conn.—and South Bend 21, Ind.**

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Agricultural Engineering

Established 1920

CONTENTS · **FEBRUARY, 1959** · **Vol. 40, No. 2**

Note: AGRICULTURAL ENGINEERING is regularly indexed by Engineering Index and by Agricultural Index. Volumes of AGRICULTURAL ENGINEERING, in microfilm, are available (begininng with Vol. 32, 1951), and inquiries concerning purchase should be directed to University Microfilms, 313 North First Street, Ann Arbor, Michigan.

AGRICULTURAL ENGINEERING is owned and published monthly by the American Society of Agricultural Engineers. Editorial, subscription and advertising departments are at the central office of the Society, 420 Main St., St. Joseph, Mich. (Telephone: YUkon 3-2700).

JAMES BASSELMAN, *Editor and Publisher*

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SUBSCRIPTION PRICE: $8.00 a year, plus an extra postage charge to all countries to which the second-class postage rate does not apply; to ASAE members anywhere, $4.00 a year. Single copies (current), 80 cents each.

POST OFFICE ENTRY: Entered as second-class matter, October 28, 1933, at the post office at Benton Harbor, Michigan, under the Act of August 24, 1912. Additional entry at St. Joseph, Michigan. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921.

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RURAL CIVIL DEFENSE UNDER DEVELOPMENT

A REVISED plan and program for Rural Civil Defense is scheduled for general public announcement in February. It is a part of the new National Plan for Civil Defense and Defense Mobilization. In the words of the OCDM, "A powerful nation, with an ideology hostile to ours, not only has declared its intent to dominate the world, but also has weapons of dreadful effect with which it might try to enforce its will. Of these effects, radiological fallout threatens rural and urban areas alike.

"Therefore, rural leaders and all rural residents are being asked to assemble in more than ten thousand mass meetings in all rural counties of the United States in late March and early April to herald the start of a new program of civil defense for rural America.

"The Rural Civil Defense Program, developed by the Office of Civil and Defense Mobilization, will inform all rural people of the threat of nuclear warfare and its meaning to them; it will tell them what they can do to save lives, protect their property; and it will show them how to do it.

"Every segment of the Nation which has rural or related interests will participate in the mass meetings. Government leadership at all levels, the large general farm organizations, state and local farm leadership and leaders of other groups involved in rural affairs, will join with rural people in the meetings.

"In cooperation with civil defense personnel from the regional through the local level, and through the farm organizations down to the local level, the Office of Civil and Defense Mobilization will provide the basic program materials for these and subsequent meetings throughout the United States.

"The OCDM program material will consist of two elements, with visual aids and special texts for areas of specific concern to rural people. They will contain full instructions for use. The first element will be presented at the mass meetings now scheduled to begin March 31, and to continue until every rural citizen has been made aware of his responsibilities to survive and to aid in the recovery effort of this nation if it ever is attacked. The second element, more detailed, is designed for a series of smaller meetings in which more time can be devoted to the 'how' of civil defense.

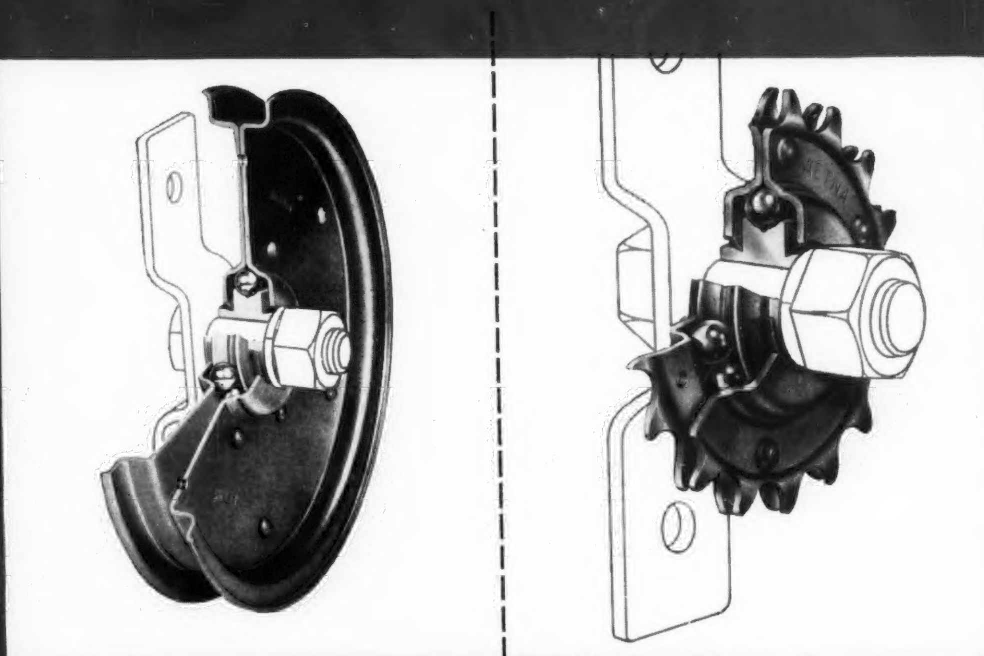
"Participating actively in the program will be local units of the American Farm Bureau Federation, the National Farmers Union, the National Grange and Farm Homemaker groups. The National Advisory Council on Rural Civil Defense, the United States Civil Defense Council, the American Association of Land Grant Colleges and State Universities, the National Association of Radio-TV Farm Directors and the Civil Defense Committee of the National Association of County Officials are among the organizations taking part."

Agricultural engineers who may be called on to advise rural groups on technical phases of the program, or who are otherwise interested, may obtain more detailed information from the Director, Rural Activities Office, Office of Civil and Defense Mobilization, Battle Creek, Michigan. Names and addresses of ASAE Section chairman and secretaries have been furnished to the office in order that they might receive further information concerning the program.

YOU CAN AFFORD

these low-cost Aetna "package unit"

BELT and SPROCKET Idlers



combining pre-lubricated-for-life ball bearings and idlers in a single mounting

Compact—easy to install—sturdy unit construction with a full complement of balls—case hardened bearing races—for anti-friction performance. Long maintenance-free service life.

Require little, if any, engineering alterations. Mount easily on sheet metal or any semi-rigid structural member with standard bolts—for all relatively light-duty, medium-speed applications.

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Step into this New World of Power—Plow up to 30 acres a day with this great new Farmall 560 tractor and new McCormick No. 70, 5-furrow trailing plow.

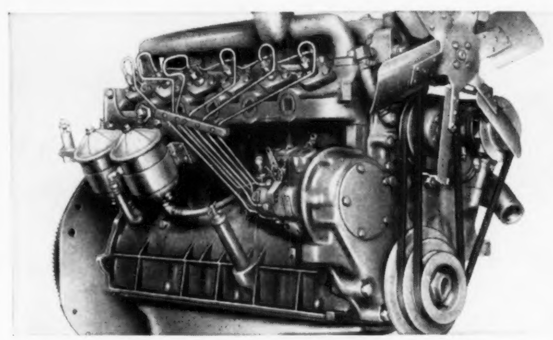
Faster . . . sm-o-o-ther . . . so e-a-s-y to drive!

NEW IH PRECISION SIX!

"Even with a big 5-furrow plow, this new 6-cylinder Farmall® romps along like a frisky colt." "I know it's the most powerful row-crop tractor built, but it's smoother . . . quieter . . . easier to run than my old 2-plow rig." "You just shift up and throttle back on lighter jobs to save up to one-third on gas!"

These are your neighbors talking. They may not even know that this new IH Precision Six has the widest governed range of any big tractor. But they've discovered a throttle setting and one of the 10 speeds forward that give them *exactly* the right power-speed combination for each of their jobs.

Now, you can hold faster speeds to hurry heavy plowing. You can mow at 6 to 7½ mph, hoe at 11 mph, or pull wider hitches to do up to 1/3 more work daily. And you farm in greater comfort . . . with less effort than ever before!



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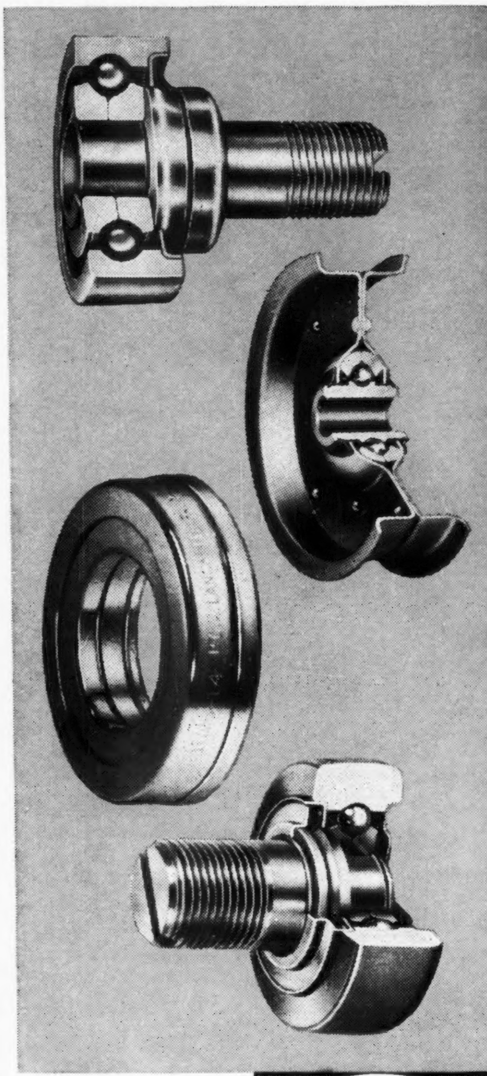
BCA ball bearings

low-cost "package units" save time in the factory, trouble in the field

BCA "package units" simplify production line installation . . . reduce manufacturing costs. Bearing, housing and seal are combined in a single, rugged unit. Each is lubricated for life and effectively sealed against water, dust and grit. Maintenance in the field is reduced . . . performance is unsurpassed. BCA "package units" are built to withstand loads, speeds and operating conditions encountered in any type of agricultural work. The "package units" illustrated are four of the many available.



HAY RAKE BEARINGS

Patented design provides for triple barrier against entrance of contaminants. Misalignment of tine bar can be compensated for without detrimental effect to bearing. Shank length, diameter, and thread can be varied to fit specific requirements.

IDLER PULLEY ASSEMBLIES

Pulley, bearing, and seal—all in one complete package unit. Adaptable to many agricultural applications, including: combines, forage harvesters, corn pickers, hay balers, grain elevators, cotton pickers. Idler design can be varied for use with flat belts, V-belts or chains.

CLUTCH BEARINGS

Exceed engineers' most severe test standards . . . over 70,000 declutchings at speeds corresponding to more than 60 M.P.H. BCA construction features: high carbon chrome balls; carburized and precision ground steel washers; single piece V-section retainer to trap grease between rotating members; labyrinth sealed with rigid pressed steel housing and special bronze ferrule, packed with a stable, high-temperature grease.

PLUNGER ROLLERS

Built with a thick-sectioned outer ring, hardened throughout, these package units are specially adapted for sliding heavy masses on rails. Principal application is in hay baler plungers, replacing plastic and metal liners, and ending the problem of wear and constant replacement. Bearings come in two types: for flat tracks, and for V-shaped tracks.

BCA

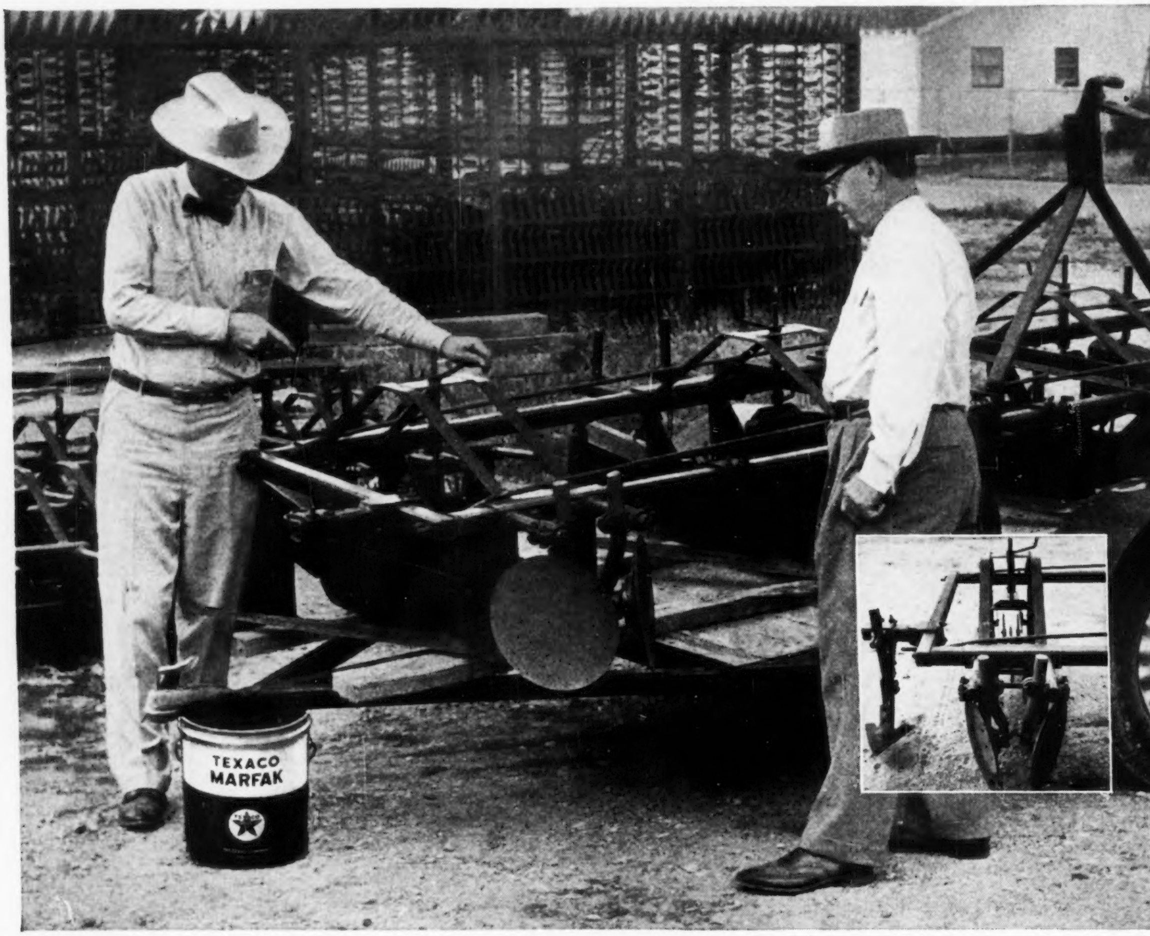
BEARINGS COMPANY OF AMERICA
DIVISION OF
Federal-Mogul-Bower Bearings, Inc.

This farm-invented "crustbuster" cuts their cultivating costs 80%!

Here's a unique piece of equipment (loaded on trailer) that does just what its name implies. In one operation, it discs, plows, knifes and scratches tough-crusted soil. It gets the planted crop up, speeds cultivation, and saves 80% of the former cost and the work of 6 men!

The "crustbuster" is the invention of Jack Bragden (left) and Ross Edwards, farmers near New Deal, Texas. It was three years in developing, and cultivates four rows of cotton or other row crops at a time—50-60 acres a day.

Jack and Ross have used Texaco products for thirty years. Like farmers all over America, they know that *it pays to farm with Texaco products.* Also, they like the neighborly, dependable services of Tank Truck Dealer Demp Webster. They can count on him—rain or shine!



(Inset) One section of the disc-plow-knife-scratch machine.

"Doggone good," she says.

John H. O'Neil of the Cheshire Oil Co., Texaco Distributors, Keene, N. H., talks shop with Ann Edwards, who helps her father, M. A. Edwards, raise hardy Scotch Highlander cattle on 10,000 acres. They agree that Texaco Marfak is the best lubricant for the brutal beating the bearings of farm machinery take, because Marfak won't drip out, wash out, dry out or cake up. It sticks to bearings—makes them *last* longer, giving better protection against breakdowns.

The Texas Company

On farm and highway it pays to use

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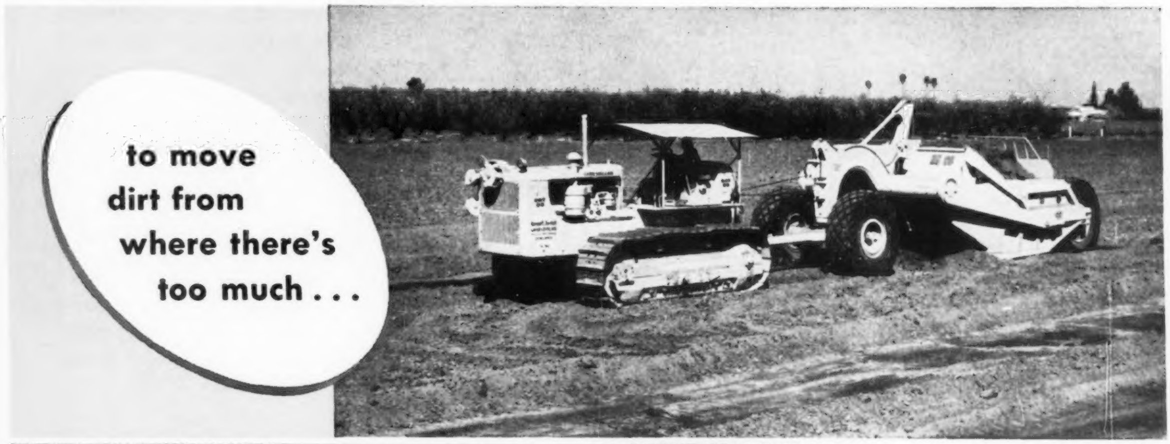
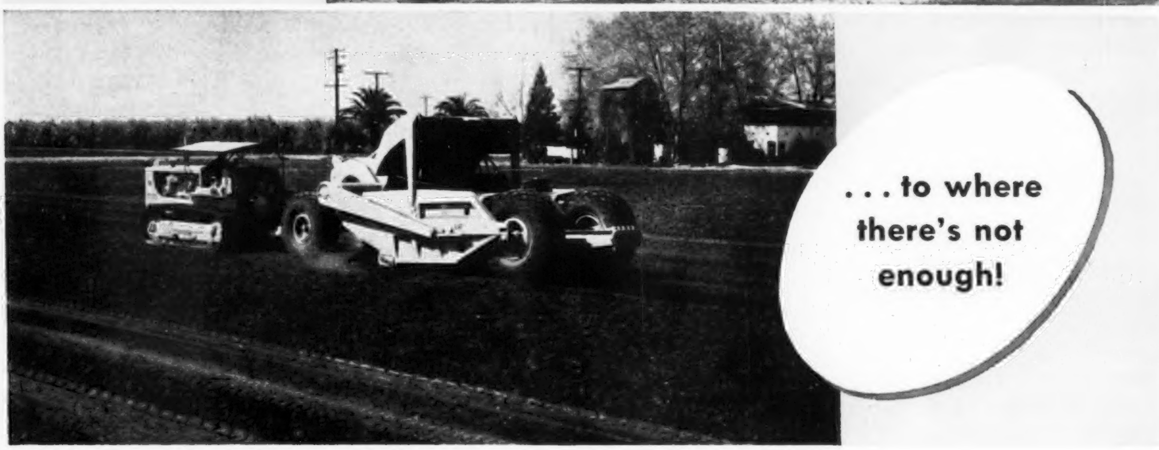
TUNE IN . . . METROPOLITAN OPERA RADIO BROADCASTS SATURDAY AFTERNOONS, CBS

Pennies per yard . . .





This is the big challenge facing today's conservationist: the job of bringing the seedbed up on a par with the rest of the farm program—with hybrids, fertilizers, insecticides, miracle drugs. For years we've assumed that little could be done about changing the face of farms. Land was cleared, tiled or ditched . . . but basically it was left the way we found it.

Today, many farmers strip hundreds of tons of earth from the high spots, and deposit them in the low places to provide good drainage and uniform water coverage. Some are even "trading dirt"—blending heavy and light soils to improve soil structure. There is virtually no limit to the capacity to improve the seedbeds.

Most practical equipment for big land forming jobs includes Cat Diesel Tractors, Scrapers and Motor Graders . . . the same machines that handle earthmoving jobs on big dams, airports and highways. Experience has shown that this is the equipment that moves more earth at lower cost than any other make or method.

When you think of building terraces, forming land, filling gullies, clearing, deep tillage, watersheds or individual farm ponds, think of efficient yellow Caterpillar machines that set the standard for the earthmoving industry!

Write Dept. AE29 for free LAND FORMING booklet. Caterpillar Tractor Co., Peoria, Ill., U.S.A.

CATERPILLAR

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Report to Readers . . .

SMALL BALE MAY BRIDGE GAP TO HAY PELLETING AND WAFERING

Interest in hay pelleting and wafering is intense. Farmers are virtually breathing down the necks of the engineers to develop the equipment they need to produce this new hay "package" . . . It is not likely, however, that the demand for this equipment will be satisfied in a hurry. The reason lies in the fact that a tortuous and costly road lies ahead for the intensive development required —one measured in years rather than in months. . . . . The why of the intense farmer interest that prevails is not difficult to understand; farmers want and urgently need easier ways to handle and store hay. May it not be, then, that an earlier and at least partial answer to this pressing need is the smaller size bale? One of the current balers makes bales as small as 12x14x18 inches, and engineers are experimenting to determine if even smaller bales may not be practical. . . . . With the short bales there is less waste of space in random stacking, and they are more suitable for handling with a mechanical bale thrower. For mow storage the small bales are better adapted for handling with such mechanized equipment as elevators and mow conveyors. . . . . So perhaps a smaller hay bale is the next natural step in the process of developing a better, more easily handled hay "package" whether wafer or pellet or both.

EFFECTIVENESS OF MOLDBOARD PLOWING COMPARED WITH ROTARY CULTIVATION

The results reported here of German experiments to compare the respective effects of plowing with moldboard plows and of rotary cultivation come to us via NIAE (England). The comparisons include soil structure, crumb size, pore volume, moisture-retention capacity, aeration, clod or crust formation, weed growth and hardpan formation. . . . . The experiments demonstrated that each implement has advantages over the other under given conditions. Mulching with a rotary cultivator, for example, resulted in higher yields, whereas the moldboard plow was found to give best results where there was no organic matter in the soil. Also, rotary cultivation on certain types of soil indicated a greater tendency to hardpan formation, excessive reduction in pore volume by settling in winter, and soil puddling. On the other hand, rotary cultivation was found superior to plowing for seedbed preparation for quick-growing crops; as a substitute for plowing and subsequent tillage especially on soil tending to retain an open structure or on very heavy soil; for breaking up sod prior to plowing or for subsequent finishing of the seedbed, and for mixing manure or plant residues with the soil.

ALTERING TREE STRUCTURE AS AID TO MECHANICAL FRUIT HARVESTING

A pomologist told a meeting of agricultural engineers that tree structure is the greatest deterrent to the success of harvesting fruit mechanically, but that his fellow scientists will try rebuilding the trees. . . . . He mentioned two approaches to changing fruit-tree structure. One would have fruiting branches hang down from the main branches to form a vase or inverted cone. This system would be suited to shaking the fruit into a catching frame, with less likelihood that it would be bruised by hitting an obstruction. . . . . In the other tree structure, two main branches would rise in a plane parallel to the tree row, at right angles to which short fruiting branches would hang or extend. Workers could then be positioned on a mobile platform for greater facility in pruning and thinning the trees and in harvesting the fruit. . . . . This system would have these important advantages: (1) Use for three high-labor operations, (2) harvest at proper size and maturity of fruit, (3) more than one picking facilitated, and (4) minimum injury in harvesting fruit for both fresh and processing markets. Principal disadvantage would likely be the expense and difficulty of training trees to the structure proposed. There is also lack of information about yields from trees so trained.

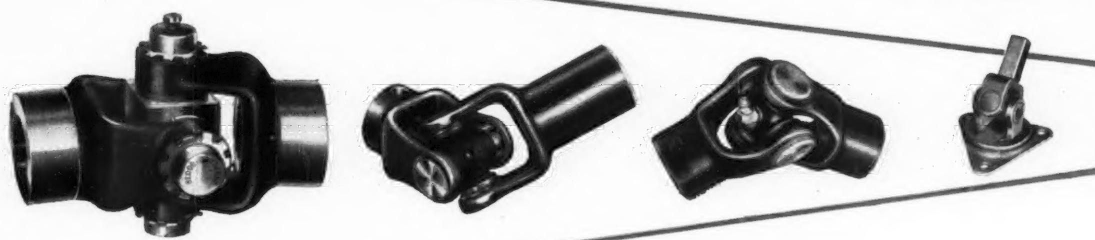
(Continued on page 66)

BLOOD BROTHERS

Universal Joints

OFFERED BY ROCKWELL-STANDARD IN SIZES FOR ALMOST ANY PRODUCT APPLICATION

SIZES AND TYPES FOR HEAVY-DUTY AUTOMOTIVE, CONSTRUCTION AND ROAD BUILDING MACHINES, FARM IMPLEMENTS, TRACTORS AND INDUSTRIAL MACHINERY.



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ALLEGAN, MICHIGAN

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ENGINEER TRIES PARAFFIN FOR COATING TRENCH SILO WALLS An agricultural engineer on the management staff of a large New England farm specializing in registered cattle reports an interesting and perhaps significant experience in the use of high melting-point paraffin on concrete silo walls. Last spring the walls of two trench silos were coated with the paraffin, and though these silos have sloping rather than vertical walls, there was no need for use of a hand fork at any time as the silage was removed. The paraffin appears to be relatively inert and, as this engineer puts it, its friction coefficient is comparable to that of a cake of soap in a bathtub. Also it seems to lubricate the contact points of the tines on the tractor loader sufficiently to prevent gouging the concrete floor of the silos. . . . . This engineer believes there may be a number of machinery and building surfaces which would benefit from the paraffin treatment—but, he warns, never, never apply it to a traffic surface; one of their silage trucks failed to negotiate a 4-inch curb that had been treated inadvertently. He further observes: "Until silicones are more readily available, perhaps we can use the high melting-point paraffins."

VACUUM BLOWER SPEEDS UP FARM FORAGE-HANDLING JOB A notable and natural trend in today's parade of new equipment offered to the farm market is to units of larger and still larger capacity. One of the latest to come to our attention is a vacuum blower designed for unloading forage wagons by suction and filling silos or hay mows, in the same operation. This blower uses a 14-inch pipeline and is said to handle about 20 tons of hay per hour. The particular advantage of equipment of this type is that it reduces labor and other costs by making special unloading operations and equipment for forage wagons unnecessary. This equipment is also adaptable to other materials-handling operations. . . . . The power source used for this blower is a gasoline engine that develops up to 87.5 hp at 3200 rpm.

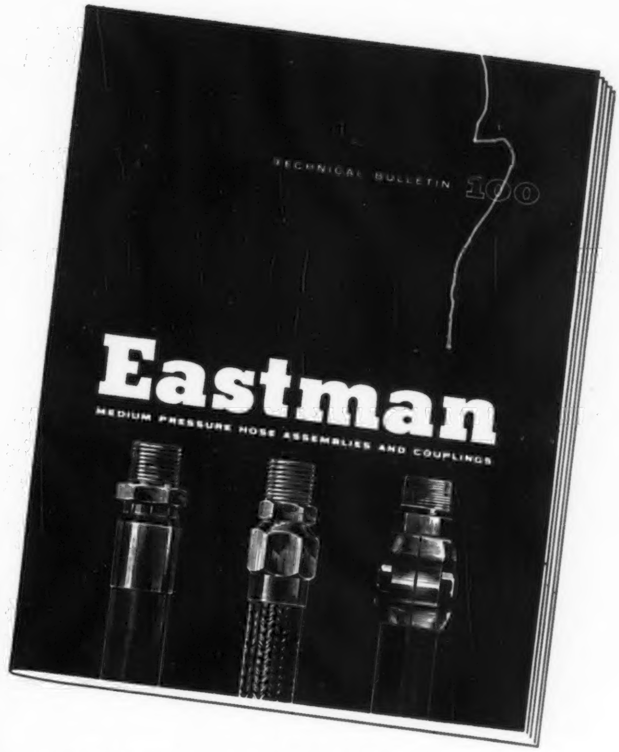
PLASTIC CORN PLANTER PLATES ELIMINATE CHEMICAL BUILD-UP The so far endless variety of useful things fashioned in this marvelous age of plastics has now reached out to include the lowly corn planter plate, ordinarily made of cast iron. . . . . Hybrid seed corn producers now treat their product with chemicals. Also, chemical soil insect killers or repellants often are mixed with the seed in the planter box. As a result, the chemicals combine with the cast-iron planter plates to build up a hard, thick layer resembling boiler scale that often interferes with planting accuracy. . . . . The new planter plates are molded from cellulose acetate butyrate, the same tough plastic used in yellow-handled screw drivers and wood chisels. This plastic resists scale build-up on the planter plate. Another advantage of the plastic plate is its low cost, much less than cast iron—an important factor since a different set of plates may be required for each grade of seed corn planted. Other advantages include good wear resistance, light weight, freedom from rust, good accuracy at high ground speeds, and less damage to seed coat.

ENGINEERS HELP TEAM IRRIGATION AND SOIL FERTILITY FOR BEST PRODUCTION EFFICIENCY In studies conducted during the past three growing seasons, USDA agricultural engineers in cooperation with the Texas AES have established the basic requirements for making the best use of the limited water resources for crop production in the semiarid High Plains areas of the Southwest by proper timing of irrigation and maintaining soil fertility. With hybrid grain sorghum as the test crop, production efficiency was highest with (a) at least 20 to 22 inches of soil moisture available during the growing season, (b) adequate soil moisture during boot and soft-dough stages of sorghum grain development, and (c) soil fertility maintained at a high level by using 240 pounds of nitrogen and 30 pounds of phosphorus per acre.

another

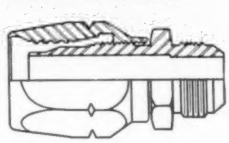
NEW BOOK
with that
Eastman
LOOK

36 pages on medium to low pressure hydraulic hose and tube assemblies



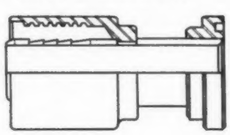
REUSABLE COUPLINGS FOR RUBBER COVER HOSE

Exclusive Eastman design directs flow of hose into machined recesses of insert and coupling body. Doubles the hold, assuring longer service. Pages 26 & 27.



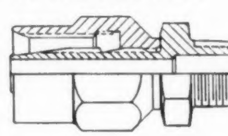
PERMANENTLY ATTACHED FLANGE HEAD COUPLINGS

Attractive, low cost permanent hose attachment—plus convenience of split-flange head couplings with 0 to 90° stems permitting full 360° positioning. Pages 20 & 21.



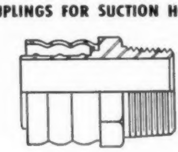
REUSABLE COUPLINGS FOR COTTON COVER HOSE

Eastman engineered two-piece coupling can be assembled without stripping hose. (Can also be used on thin rubber cover hose without removing cover.) Full details on pages 24 & 25.



PERMANENTLY ATTACHED COUPLINGS FOR SUCTION HOSE

For use on spiral wire return lines. Maximum orifice permits rapid return of hydraulic fluid assuring adequate supply from lever to load for top payload power. See page 31.



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Determine the proper couplings
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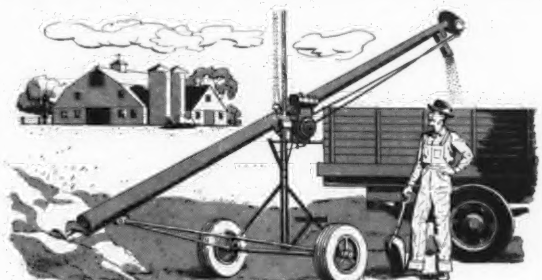

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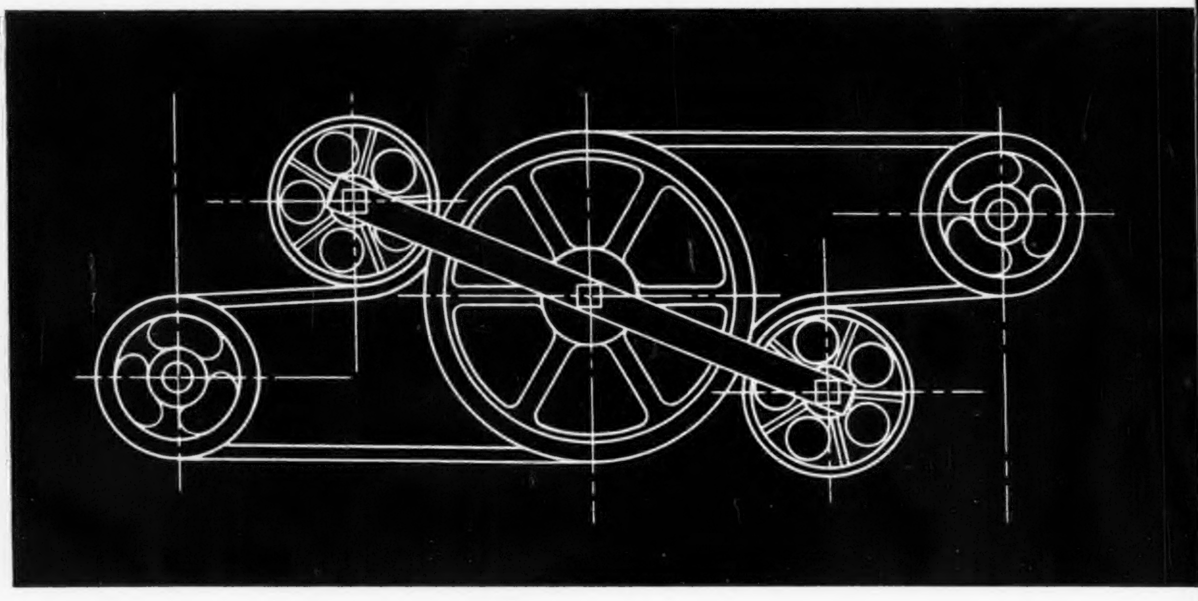

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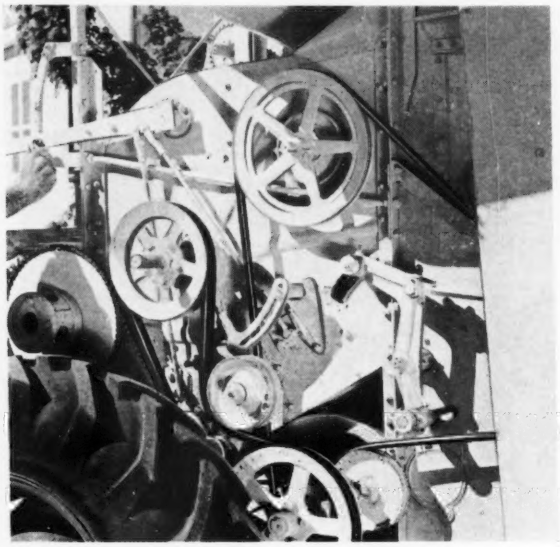

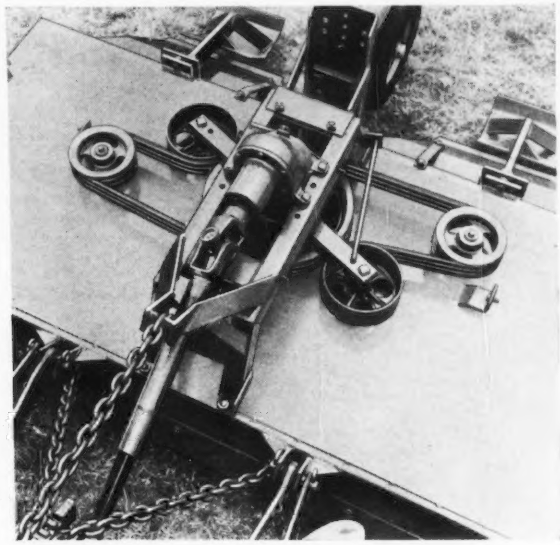

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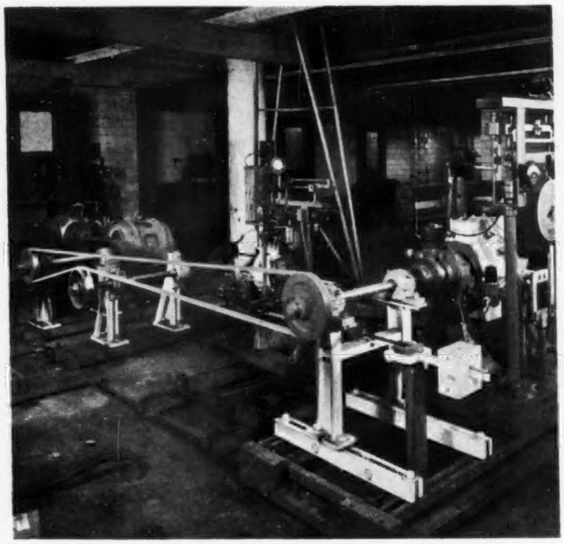

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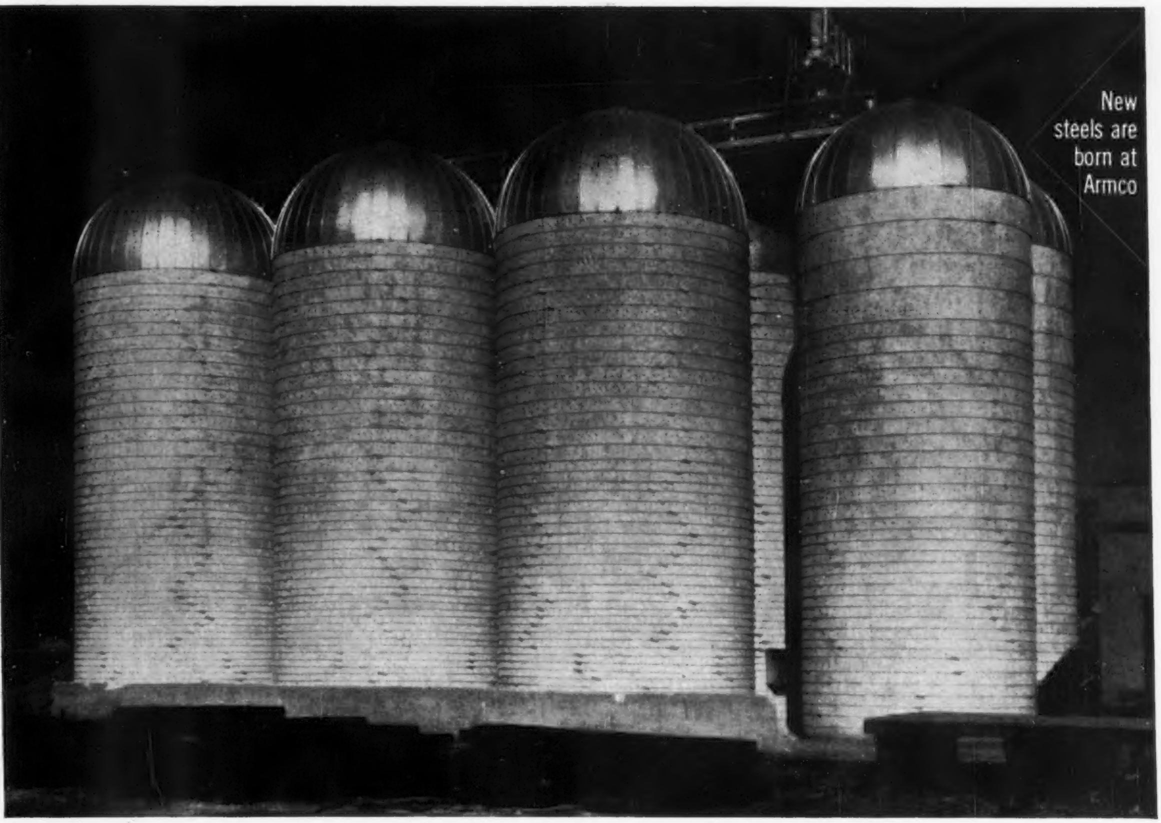

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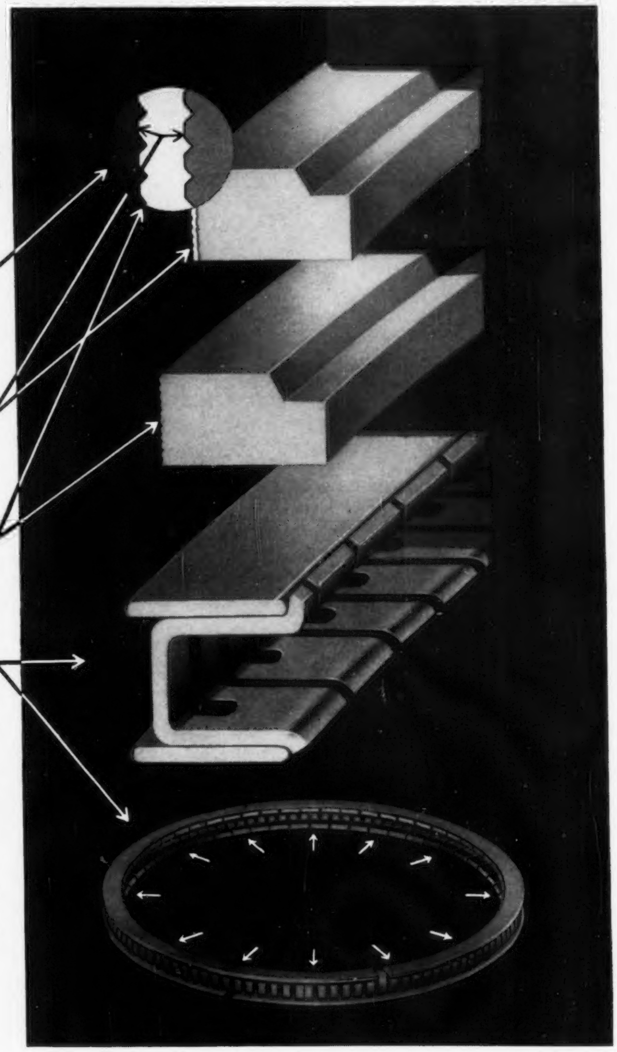

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Agricultural Engineering

February 1959
Number 2
Volume 40

James Basselman, *Editor*

Informing the Public

ASAE's public relations, especially the area involving publicity or promotion of the agricultural engineering profession with the general public, received an important assist during the ASAE Winter Meeting in December. For the first time during the history of this Meeting the Chicago Section of ASAE obtained the services of a professional public relations agency to handle publicity. In order to get some idea of the magnitude of the public relations activities connected with the Society, or for that matter one meeting, following is a partial list of the many "contacts with the public" arranged by the Julian J. Jackson Agency before and during the Winter Meeting and listed in a report by T. E. Clague, publicity chairman of the Chicago Section.

Mimeographed news stories announcing the Winter Meeting were prepared and distributed to 1,018 publications and broadcast media. A questionnaire was mailed to radio and television stations to determine if they could use and if so what type of taped interview they would prefer. This resulted in requests for 504 of these tapes from over 70 radio stations. A total of 22 news release digests were prepared from 50 papers submitted in advance and were mailed to Chicago daily newspapers and broadcast media as well as to a list of selected publications. Arrangement was made with Mayor Daley's office for the issuance of a proclamation, which the agency prepared, naming December 15-19 Agricultural Engineers Week in Chicago. Hometown newspapers also received localized news stories telling of speakers who presented papers during the Meeting. Radio and television contacts resulted in the appearance of Robert Barnick, S. C. Heth, Robert Rowe, Walter Carleton and Carl W. Hall on the "Farm Daily" show over WBBM-TV; Lloyd Hurlbut and Carl W. Hall were guests on the "Tony Weitzel Show," on WBBM; George Nutt was guest on "Town and Farm," over WNBQ; Keith Pfundstein was a guest on "Don McNeill's Breakfast Club," over WLS; and C. B. Richey appeared as a guest on "Dinnerbell Time" on WLS. An interview which featured Wayne Worthington and Karl Butler was taped for NBC for use on "Night Line" network program January 27. The same program was recorded by Jim Hurlbut for "Voice of America." An interview with Mr. Crouzet, a French representative who attended the meeting, was also taped for "Voice of America."

As a result of these many contacts, the terms "agricultural engineers," "agricultural engineering" and "American Society of Agricultural Engineers" were heard and read by thousands of the general public, some perhaps for the first time. Certainly, if the profession of agricultural engineering is to increase in size this is necessary. The Chicago Section of ASAE is to be congratulated for the foreward step it has taken.

Transactions Report

THE editor and members of the ASAE headquarters staff acknowledge and thank all those who have written in or otherwise announced their approval of the recently introduced TRANSACTIONS of the ASAE. Advance orders from ASAE members for the second edition have already exceeded expectations. Orders from subscribers, although coming in at a slower rate than had been anticipated, are beginning to increase in number daily and should reach the minimum necessary for financing an issue consisting of at least 128 pages. The slower response from subscribers can be attributed in part to the increased time required for copies of Volume 1 to reach overseas subscribers and for their orders to be returned.

Acceptance of the new publication offers a partial solution to the Society's publications problem by making more technical papers available in the printed form, than is possible in the present Journal. As a companion publication to the Journal, it can carry important agricultural engineering literature which has permanent value and which should be recorded for present and future reference. As it grows in size and circulation more emphasis can be placed on broad interest and timeliness of publication for articles to be used in AGRICULTURAL ENGINEERING.

Articles published in the Transactions are selected in the same manner as those published in AGRICULTURAL ENGINEERING. All papers presented at national ASAE meetings and other papers submitted by the author are considered for publication. Following each national ASAE meeting all papers presented are given a priority rating by members holding responsible positions within the Division in which the paper was presented. Papers are then sent to Critical Readers in the order of priority for careful evaluation. Each reader is asked to fill out a questionnaire prepared to provide the editor with sufficient information about the paper, so that he in turn can compare it with others on the same subject.

The questionnaire permits the critical reader to express his opinion, to make recommendations regarding publication, and to offer suggestions for improvement. It also provides a degree of uniformity in grading. Critical Readers remain anonymous to permit rendering advice freely without personal embarrassment.

Increased acceptance of the new Transactions will help the Society in its obligation to publish all worthy technical literature. Since press run will be based on advance orders, delivery on Volume 2 cannot be guaranteed on orders received after March 30, 1959.

Engineering Appraisal of Hay Pelleting

John B. Dobie
Member ASAE

Engineer says success in mechanizing the storage and feeding of hay calls for a new hay package to facilitate handling and feeding operations

MECHANIZATION of hay storage and feeding, though of high priority for several years, has been only partially successful thus far. Further progress requires a new hay package—one that will facilitate mechanical handling and feeding. Since hay is a comparatively low-value crop, cost of preparing this package must be kept as low as possible.

Pelleting first became popular for poultry and rabbit feeds, many of which feeds contained dehydrated alfalfa. More recently alfalfa dehydrating plants found certain advantages in pelleting alfalfa meal. In so doing it was found that hay could be pelleted without a binder, but at a lower machine capacity than for mixed feeds. Work with chopped hay pellets two inches or more in diameter, by Bruhn(1)* at the University of Wisconsin, increased interest among farmers and manufacturers. Prior to this, pelleting had been considered too expensive for sun-cured hay. The larger coarse-hay pellet seemed to open the way for reduction in pelleting costs and started serious thinking about in-the-field pelleting.

Paper presented at the 51st Annual Meeting of the American Society of Agricultural Engineers at Santa Barbara, Calif., June, 1958, on a program arranged by the Electric Power and Processing Division.

The author—JOHN B. DOBIE—is specialist in agricultural engineering, University of California (Davis).

Acknowledgment: The author is grateful to cooperating members of the departments of animal husbandry and agronomy, University of California at Davis, and to the California Committee on the Relation of Electricity to Agriculture for financial support for this project.

*Numbers in parentheses refer to the appended references.

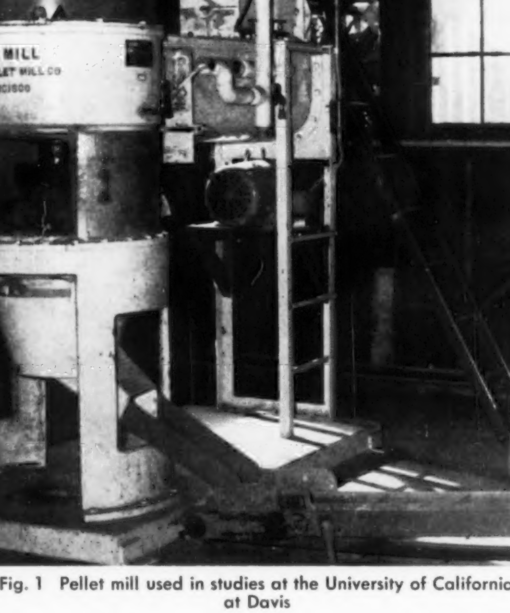


Fig. 1 Pellet mill used in studies at the University of California at Davis

Research on hay pelleting has progressed in three directions; as follows:

(a) Conditioning raw material and handling finished product: Little basic information has been available on the optimum condition of material for pelleting. With the development of pellets in new and various forms, these products must be studied as to storage and handling characteristics.

(b) Feeding trials: Development of a product of inferior acceptability to livestock would be a short-sighted approach. Various kinds of pellets for feeding tests are provided by the agricultural engineer.

(c) Development of equipment: Numerous manufacturers now have research under way or machines in the development stage. Eventual machine design will depend somewhat upon the results of feeding trials and the materials-handling characteristics of the product. Studies of all phases of the problem are progressing concurrently.

A pilot plant was installed at the University of California at Davis for studying the variables that affect hay pelleting. Much of the production of this plant has been used in feeding trials. In addition, through the cooperation of commercial concerns, some information has been obtained on the processing, handling, and feeding of larger pellets, commonly referred to as wafers or biscuits.

Particle Size Within the Pellet

One of the most important problems in the field of hay pelleting, both to livestock feeders and machine designers, is the size of the particles in the pellet. Early feeding trials with meat-type animals were conducted with pellets made from finely ground hay, usually passed through a $\frac{3}{64}$ or $\frac{4}{64}$-in. screen. Because of greater hay consumption, gains were greater from roughage in pelleted form than from long or chopped hay. More recent work, also with meat animals, indicates that the small particle size may produce better results than coarse hay because the animals can assimilate the ground feed faster(2). Pelleting provides a more edible form for finely ground roughage. In a recent experiment at the University of California at Davis, under the direction of J. H. Meyer, sheep ate significantly more pellets made from $\frac{1}{16}$-in. screen ground hay than from $\frac{3}{16}$, $\frac{5}{16}$, or $\frac{1}{2}$-in. screen grinds. However, when fed on a self-selection basis, the sheep preferred the coarser grinds. These results are shown in Tables 1 and 2. Physical characteristics of the pellets are shown in Table 3.

In producing ground-hay pellets, fineness of grind materially affects the operation of the pellet mill. Finer material is more dense, feeds through the mill easier, and results in greater pelleting capacity. When coarser hay is

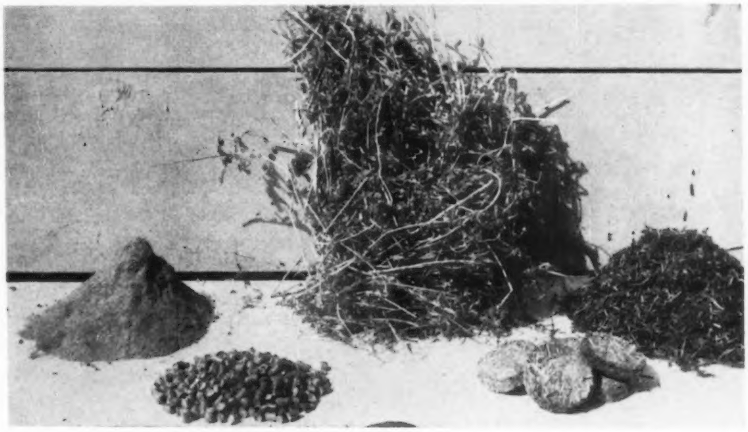


Fig. 2 One-pound samples of hay in various forms. ***(Left to right)*** **1/16-in. screen grind, 3/8-in. pellets, baled, 4-in. wafers, and chopped hay**

pelleted, grinding may occur in the pelleting chamber, with a resultant loss of capacity and increase in pellet temperature. In preparing the pellets reported on in Table 3, it was found that hay ground through a 5/16-in. screen could be made into 3/8-in. pellets with very little additional grinding. With any coarser grind, the larger particles were reduced in size during pelleting , so that the particle size in the pellet was comparable to 5/16-in. screen grind. This relationship seems to apply with large pellets also. The die-hole diameter should be 1/8 to 1/4 in. larger than the hole size in the grinder screen.

Reports on feeding pelleted hay have been less encouraging with dairy cattle than with meat animals. Some reports indicate a reduction in butterfat content of milk when all the forage is fed in pelleted form; others show little or no loss. Hay consumption also varies, with some trials showing an increased intake when hay is fed in pelleted or wafered form.

The question naturally arises: what is the minimum average particle size of hay that can be fed in pelleted form without causing a reduction in butterfat? To date, this question has not been answered satisfactorily. A recent trial at Oregon State College(3) showed that the butterfat content of milk was slightly less from 5/16-in. screen-ground hay pellets than from baled or 3-in.-diameter wafered hay. A study (4) of all available reports indicates that variables in the ration other than pelleted hay may have caused the butterfat reductions noted.

TABLE 1. INFLUENCE OF SIZE OF GRIND ON CONSUMPTION OF PELLETS†

	Grinder screen size 1/16 in.	3/16 in.	5/16 in.	½ in.
Number of sheep	8	8	8	8
Daily feed consumption, lb	4.60*	4.33	4.39	4.44
(Feed consumed per unit of weight)$^{3/4}$, lb	0.26*	0.24	0.24	0.24

*Difference statistically significant.
†Latin square design (2 sheep per square).

TABLE 2. INFLUENCE OF SIZE OF GRIND ON SELF-SELECTION OF PELLETS†

	Grinder screen size 1/16 in.	3/16 in.	5/16 in.	½ in.
Percentage of daily ration	15	16	38	31

†Five sheep, two two-week periods.

TABLE 3. PHYSICAL CHARACTERISTICS OF PELLETS USED IN SIZE OF GRIND EXPERIMENT

	Grinder screen size 1/16 in.	3/16 in.	5/16 in.	½ in.
Diameter of pellet, in.	3/8	3/8	3/8	3/8
Density of pellet, lb/cu ft	63.7	64.3	63.85	66.0
Crushing strength, lb/sq in.	1602	1880	2159	2315
Water-penetration rate†	4	3	1	2

†Comparative rate: 1 is fastest, 4 is slowest.

Pellet Size

Much work in progress is attempting to determine the optimum pellet size for direct feeding of hay. Hay pellet diameters now range from 1/4 to 4 1/4 in. in diameter. Pellets made from finely ground hay in the standard pellet mill are usually 1 to 1 1/2 diameters long, hence are close to cubes in proportions. The larger pellets, hereinafter referred to as "wafers," are usually only one-quarter to one-third diameter in length.

The wafers are mostly being produced by experimental machines using chopped or long hay. The product is quite different from the small pellet. Because of the many variables of particle size, density, handling characteristics, palatability, and edibility, extensive experimental work will be needed before valid comparisons can be made. Simply comparing small pellets with large hay wafers is not enough. The eating habits of cattle appear to vary considerably with changes in density, diameter, and diameter-to-length ratio. Although there is some standardization in pellets, hay wafers are still largely experimental, and the best size, shape, and density have yet to be determined.

The interest in hay wafers has come about in an attempt *(a)* to avoid the problems encountered in feeding finely ground hay pellets to dairy cows, *(b)* to obtain greater capacity per horsepower, and *(c)* to eliminate the grinding operation before pelleting. It appears (3, 5, 6) that wafers compare favorably with baled or chopped hay for dairy cows. Differences between wafers and ground-hay pellets are not great enough to indicate a definite preference. In general, the wafer-producing machines have required about the same horsepower per ton per hour as that required by the standard commercial pellet mill. Full production models may show considerable improvement in this respect. Elimination of the grinding operation is important since fine grinding requires at least as much power as pelleting does.

(Continued on page 92)

Fig. 1 Tractor with automatic guiding system

"Automatic Pilot" for Farm Tractors

C. B. Richey
Member ASAE

Engineering development takes over routine guiding in field operations; thereby, easing strain on operator and enabling him to watch his machine more closely

ADVENT of power steering on tractors brought up the possibility of automatically guiding a tractor down a crop row, plow furrow or windrow, if satisfactory sensing and control devices could be developed. The growing size and complexity of modern field machines has taxed the ability of the operator to accurately guide the tractor and simultaneously watch the action of the machine for proper functioning. An automatic guiding system should not only greatly reduce fatigue but also result in more efficient operation of the machine.

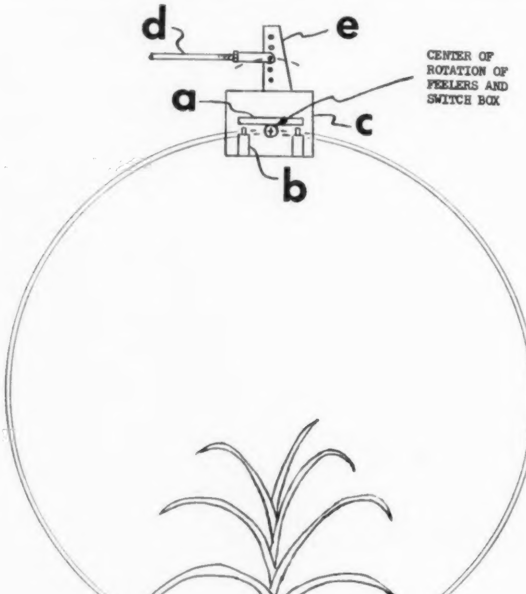


Fig. 2 Arrangement of feelers and microswitches

When a project to develop an automatic steering system was initiated, the following features were considered to be desirable:

(a) Compatibility with regular power steering.
(b) Easy changeover from automatic to manual control for turning and centering on the row.
(c) No reduction in field speeds compared to manual steering.
(d) Adaptable to the majority of field operations.

Needless to say, simplicity, ruggedness, and an economic cost were prerequisites.

Development

Consideration was first given to sensing row position by a photoelectric cell. The factors of sunlight and shadow, wind blowing plants to one side and weeds appeared to introduce insuperable handicaps to the development of a satisfactory reflectance system.

Mechanical sensing by feelers straddling a crop row offered the best possibilities. Long lightweight feelers activating low-effort microswitches were used for maximum sensitivity to small plants. They were mounted on a longitudinal pivot above the row. These switches controlled relays carrying current to an electric motor. The motor powered a screw mounted in the drag link as shown in Fig. 1. This system enabled the tractor to be guided either by the action of the powered screw varying the length of the drag link or by the steering wheel moving the entire drag link.

Paper presented at the Winter Meeting of the American Society of Agricultural Engineers in Chicago, Ill., December, 1958, on a program arranged by the Power and Machinery Division.

The author—C. B. Richey—is chief research engineer, Tractor and Implement Division, Ford Motor Co.

The steering wheel, however, had to be held stationary against the thrust reaction of the screw during automatic guiding.

The first control system continued to angle the front wheels in the corrective direction as long as the feelers were displaced from neutral. Provision was made for automatic return of the front wheels to a straight-ahead position as soon as the feelers returned to neutral. When tried on a row of stakes, this system had the obvious fault that the front wheels were still angled when the feelers came back to neutral, resulting in overshooting and completely unstable operation.

It was apparent that, in order to correct overshooting, the wheels should be straightening as the feelers were returning to center. This was accomplished by devising a mechanical followup or servo connection which controlled the amount of front wheel angle in proportion to feeler displacement. If the feelers were displaced a given distance, the front wheels were angled a given amount and then held there. This system was tried on a row of stakes and gave indications of being workable.

Trial-and-error experiments were made varying the rate of corrective wheel angling. It was found that the necessary *rate of angling* depended on the curve radius to be followed and the speed of the tractor when approaching the curve. The wheels had to angle fast enough to keep up with the change in direction. (The rate of angling does not change with tractor speed since it is controlled by a constant speed electric motor operated from the tractor battery.) Since this system tends to hunt, with the screw turning continuously in one direction or the other, higher screw speed means more reversals and mechanical wear. Thus, screw speed should be no faster than necessary.

Various amounts of wheel angle per increment of feeler displacement were also investigated. As shown in Fig. 2, displacement of the feelers to the right in a counterclockwise direction rotates the switch-actuating bar *(a)* to close microswitch *(b)*. Actuation of the steering screw then steers the tractor to the right and also rotates the microswitch box *(c)* in a counterclockwise direction through the push-pull cable connection *(d)* from the screw to lever *(e)*, canceling the signal by opening the switch. A long lever requires more correction before canceling than a short lever. A high *correction ratio* (degrees of wheel angle change per inch of feeler displacement) gave maximum precision at low speed but became unstable at higher speeds. Lost motion in the push-pull follow-up cable tended to increase the effective correction ratio. It was found that a correction ratio controlling the tractor within approximately a 4-in. band permitted cultivating speeds up to 6 mph under favorable conditions. It was also found that the feeler's point of action should lead the front wheels by at least 15 in.

The microswitches are usually set for a null band about 1 in. wide. Excessive width of the null band, of course, decreases accuracy. On the other hand, if too narrow, an excessive number of reversals results.

Accuracy and stability characteristics are a result of the interaction of four factors: *(a)* rate of angling, *(b)* correction ratio, *(c)* feeler lead and *(d)* width of null band. These relationships were not exhaustively explored but workable combinations were developed. It should be possible to express these relationships mathematically and to determine the optimum values for best performance.

After good functional characteristics were attained, the power steering control valve was modified to reduce the actuating effort to a point where friction of the steering gear held the screw reaction, making it unnecessary to hold the steering wheel stationary.

It was also found desirable to raise the feelers during transport and when turning at the ends. This was accomplished by mounting the feeler and microswitch assembly on a parallel lift linkage connected to the cultivator lift shaft or directly to the tractor rear-lift arm as shown in Fig. 1.

Operation

It is usually best, although not mandatory, to switch off the automatic guiding system while turning at the ends, since inertia and any drag of vegetation cause the feelers to signal for an opposing turn. It is necessary to center the tractor on the row after turning and to bring the steering wheel to centered position before switching on the automatic guiding. If the tractor tends to drift over on a side slope, the steering wheel can be turned enough to compensate. When the land levels out, the wheel must be turned back to the original position. The steering wheel can override the automatic system at any time.

In cultivating corn, it has been found that the plants must be a minimum of 10 in. high with pencil sized stalks near the ground for sufficient stiffness to actuate the feelers. Weeds up to half the height of the corn have not prevented satisfactory operation and a single large weed off the row does not usually hold the feelers long enough to lose the row.

(Continued on page 93)

Fig. 3 Automatic guiding on a furrow wall

Construction for Controlled-Atmosphere Apple Storage

I. J. Pflug
Member ASAE

D. H. Dewey

Refinements in regular storage techniques as well as special construction features and equipment constitute the principal requirements for adequate controlled-atmosphere storage of apples in Michigan.

MOST Michigan apples are stored at the orchard in structures built and operated by fruit growers. Whereas many farm structures are becoming simplified and less costly in construction, the trend is the opposite for fruit storages. More expensive and complex storages are necessitated by advanced techniques such as the controlled atmosphere method of storing apples. Controlled atmosphere storage is becoming widely accepted for apples since it provides better preservation of quality; also it controls certain storage disorders, such as brown core of McIntosh and spot and soft scald of Jonathan apples which are often severe in regular refrigerated storage.

Controlled atmosphere (CA) storage requires low temperatures (32 to 38 F, depending on varieties) and modification of the oxygen and carbon-dioxide levels of the atmospheric gases surrounding the fruit. The physical requirements for attaining these conditions are discussed in this paper under the heading of structure, gasproof lining and seal, refrigeration system, and auxiliary equipment.

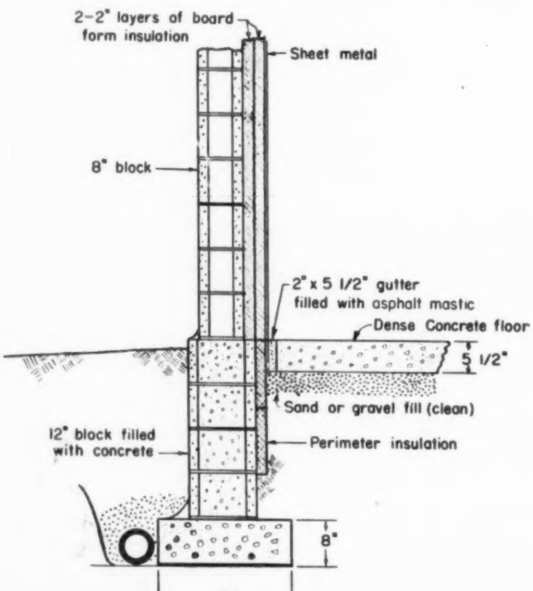
Paper presented at the 51st Annual Meeting of the American Society of Agricultural Engineers at Santa Barbara, Calif., June, 1958, on a joint program arranged by the Farm Structures and Electric Power and Processing Divisions. Authorized for publication as Journal Paper No. 2277 of the Michigan Agricultural Experiment Station.

The authors—I. J. Pflug and D. H. Dewey—are, respectively, associate professor of agricultural engineering and associate professor of horticulture, Michigan State University, East Lansing.

The Storage Structure

The insulated structure is the basic component of the CA storage. Since apple storages are an integral part of the fruit farm operation, the size of the structure will depend upon the nature of the orchard operation and the grower's interest in utilizing it as a marketing tool. Rooms of 10,000 to 12,000 bu capacity are ideal in size for most operations since they can be readily loaded, economically operated and quickly unloaded once the room is opened. Growers of large quantities of apples utilize buildings with several rooms as a means of providing the required capacity, for storing several varieties, and for lengthening their market period for the apples.

Michigan storages are designed for fork-lift truck operation with floors at ground level, doors 5 to 6 ft wide and 8 to 9 ft high, and minimum ceiling heights of 18.5 ft. Standard practice is to stack the bushel crates of fruit on pallets, five crates high, and then stack three pallets high (total of fifteen crates) in the storage, or if the fruit is in 30-in. bulk boxes, they are stacked six boxes high. At least



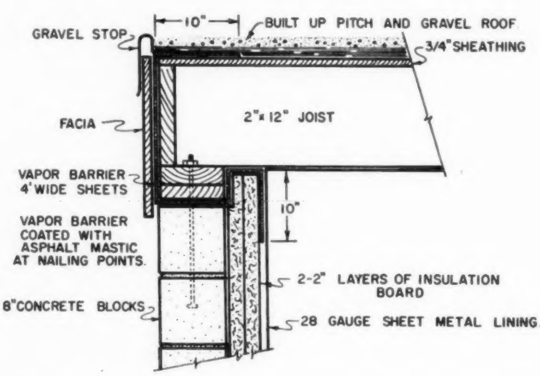


Fig. 2 *(Above)* Roof-wall juncture showing vapor-barrier location for flat roof

Fig. 1 *(Left)* Floor-wall juncture detail showing method of forming gas seal

one foot of clear space above the boxes of fruit is required for adequate air movement.

Michigan storage-construction recommendations do not include insulation in the floor. A concrete floor of 4-in. minimum thickness is poured on a sand or gravel fill that is well-drained and firmly compacted. Two inches of perimeter insulation extending 1 to 2 ft below the top of the floor, as illustrated in Fig. 1, is recommended. Where single-wall construction is used, the wall insulation is a continuation of the perimeter insulation. Perimeter insulation for the storage having double-wall construction can be provided by extending the double wall 12 in. below the bottom of the floor.

Walls of the building may be constructed with a single wall of concrete blocks insulated with a board-form insulation, or with a double or cavity wall insulated with fill-type insulation. They may also be constructed by the tilt-up method(4)* where the concrete is poured and compacted into a dense monolithic mass in a horizontal position and then erected by suitable power equipment to form the vertical walls. Board-form insulation is utilized in this method of construction. The thickness of the insulation will vary with the material used but should be equivalent to 4 in. of corkboard.

For the single-room structure the shape of the roof (arch, gable or flat) is not important; however, the addition of a second room or packing house to a gable or arch-roof structure presents problems of attachment and maintenance. Where the storage plant is likely to undergo further expansion, a flat roof is usually desirable.

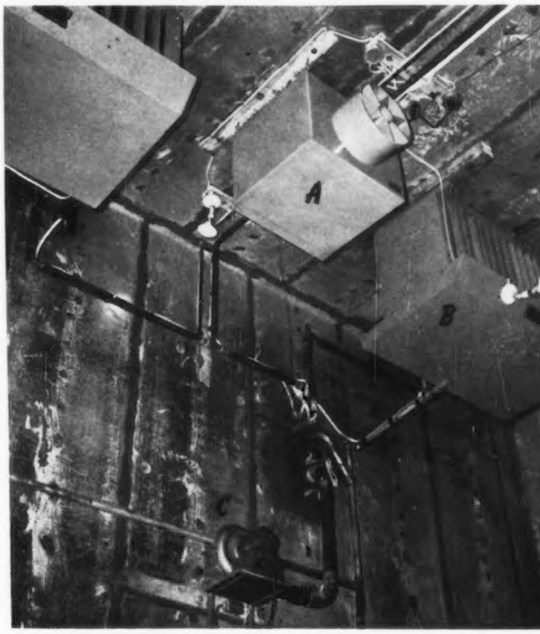
Steel or concrete roof construction is more expensive than wood, but has the advantages of being fire-resistant and rotproof. For rooms up to 24 ft wide, wood joists that extend from wall to wall are used. Wood joists supported on I beams can be used for rooms of greater width. Flat, arched or gable-type steel trusses can be used with either wood or metal joists for large rooms. Ceilings require 4 to 5 in. of insulation, which may be applied in granular, blanket or board form.

The external vapor barrier is essential in the controlled-atmosphere storage since the internal gas lining is resistant to the flow of water vapor as well as carbon dioxide and oxygen. A poorly applied or permeable external vapor barrier will allow moisture to accumulate in the space between the outside and internal vapor barrier. This problem is minimized if a board-form insulation impervious to vapor penetration is used. Moisture accumulation is most serious in fibrous or granular insulation materials whether applied as fill or in bats.

A commercial grade pitch and gravel built-up roof is gastight and serves as the outside vapor barrier for the ceiling, but the ends of the supporting joists are difficult to seal. A method of providing an adequate moisture barrier to the ends of wood joists is illustrated in Fig. 2.

The cost of the storage structure generally ranges from one to two dollars per bushel of storage space and is about one-half the total cost of the completed storage. The most economical type of construction will utilize wood in a great many places, while the most expensive construction is a fireproof structure of masonry and steel. Since the storage

Fig. 3 Interior of sheet-metal-lined CA storage. A, carbon air purifier; B, refrigeration evaporator, and C, air blower for carbon dioxide absorber



structure is a functional building, the builder should be cautious of false economies as well as expensive frills. The optimum building design will provide the desired longevity at minimum per-bushel storage cost.

The high humidity conditions required for satisfactory fruit storage are favorable for the development of rot and accompanying deterioration of the building; therefore, a wood structure may be of considerably shorter useful life than a steel and masonry structure. Wood, when used, should be of a decay-resistant variety like redwood and properly treated with a preservative prior to installation.

Sealing Controlled-Atmosphere Storage

The gas seal is critical for the successful operation of the CA storage. Since complete air tightness is not feasible, Pflug and Dewey(3) calculated the rate of leakage of the CA storage that can be tolerated and still permit development of a desired atmosphere as a function of the fullness of the room and the rate of respiration of the fruit. The maximum leakage allowable for a CA room may be as low as 0.028 air changes per day, or one air change each 35.7 days. The gas seal must maintain this low leakage rate against continuous pressure differentials that may be as high as 0.1 in. of water gage(8). A breather bag is a practical necessity in small rooms to keep these pressure differentials to a minimum(1, 2).

Although many materials can be used for the gas seal, galvanized sheet steel is generally recommended(7). The interior of a sheet-metal-lined room is illustrated in Fig. 3. Flexible materials, such as paper and plastic films, must be glued in place with the joints taped together. Their lack of rigid strength makes it difficult to attain an adequate seal. In 1958, however, two 12,000-bu CA rooms were success-

*Numbers in parentheses refer to the appended references.

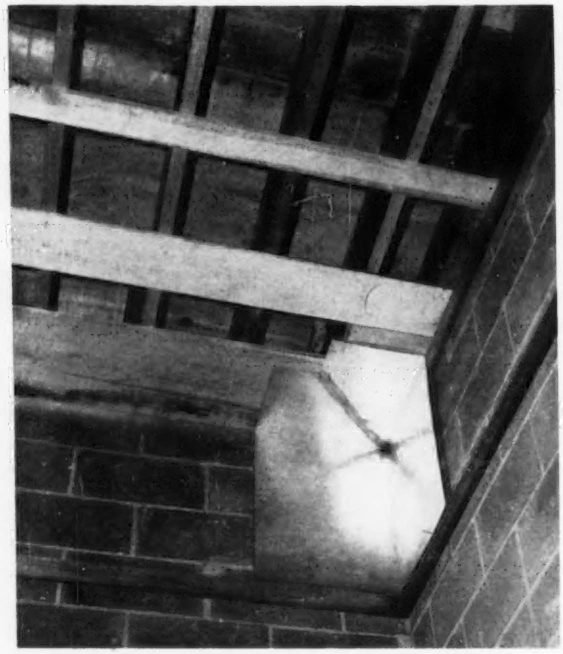


Fig. 4 Prefabricated sheet metal corner

fully lined with a mylar-aluminum foil laminated film adhered to board-form polystyrene insulation with a cold asphalt adhesive.

Galvanized sheet steel (28-gage) is used to provide the gas seal in most Michigan CA storages. The sheets of steel are lapped at least 1½ in. and the joint is sealed with non-hardening, odorless caulking compound (such as Pecora) within the lap joint plus an external covering of the nail heads and the exposed edges of the joint.

The sheet metal is nailed to ¾-in. furring strips. Where concrete block walls with board-form insulation are used, the furring strips may have to be anchored through the insulation to the blocks. Another method of attaching the furring to board-form insulation is to route out an area of insulation equal to the area of the furring strip and then glue the furring strips to the insulation, after which the sheet metal can be applied against the insulation. All wood furring should be treated for decay resistance.

Construction of the gastight lining at the ceiling is simple where wood joists are used without posts or beams in the room since the sheet metal is applied directly to the bottom of the joists as shown in Fig. 2. A two-by-four is toenailed between the joists at the juncture of the steel sheets to insure a tight joint. The joints in the ceiling are caulked in the same manner as in the walls.

A prefabricated corner, as shown in Fig. 4, will simplify construction and assure a good seal in these areas.

Steel rafters or ceiling joists supporting a sandwich-type board-form insulation roof deck or a steel roof deck present special sealing problems. A false-ceiling can be constructed at the lower edge of the joists to support the sheet-metal ceiling, or the gastight built-up roof at the top of joists can be joined tightly to the wall seal.

Experience gained through experimentation during the past few years indicates that a dense concrete floor is sufficiently resistant to air movement to serve as a seal. The floor, however, must be free of open cracks or other breaks. Care must be taken to join the dense concrete floor to the wall steel with an airtight juncture. One method of sealing this juncture is illustrated in Fig. 1, whereby a 1¾-in.-wide gutter is formed between the perimeter insulation and the edge of the floor into which the wall steel is extended at least 3.5 in. To complete the seal, the gutter is filled with an asphalt mastic that will remain flexible at 32 F.

Once the room is filled the seal is completed by bolting a metal door against the wall steel. The door normally contains a window for observing a thermometer and the fruit inside the room. A hinged porthole is also desirable for removal of fruit samples and as a vent when air is added to the room.

Refrigeration

Retention of fruit quality in a controlled-atmosphere storage is dependent upon low temperatures and high humidities as well as the modified atmospheres. The CA storage must be adequately refrigerated to rapidly remove the field heat during the loading period and designed to maintain a high relative humidity (90 to 95 percent) at 31 F. Adequate air distribution for rapid cooling and uniform temperature of the entire mass of fruit is essential. The refrigeration system should be provided with instrumentation that will control the temperature in the storage within narrow limits ($\pm$0.5 F).

The refrigeration system should be equipped with positive defrosting evaporators. They are essential for rapid cooling of storages operated at temperatures above freezing as well as for storages in which the fruit is held at 31 to 32 F. Water defrost evaporators of the ceiling-mounted and floor-mounted types are being used successfully; however, an elaborate trapping system is necessary to allow the water to drain from the evaporator without air leakage. The temperature of the defrost water must be 50 F or below to prevent excessive pressures developing in the room from vapor evaporation during defrosting. Electric defrost ceiling-mounted evaporators also have been proven satisfactory. These units do not require additional plumbing, but have the disadvantage of requiring a heavy electrical service. A few brine-spray evaporators are used and while these operate satisfactorily, they are unpopular in Michigan because of the rather high maintenance costs due to the corrosive action of the salt.

Regardless of the defrost system, the evaporator must have adequate cooling surface so that a high humidity is maintained even during the cooling-down period. Once the fruit is cooled, a properly adjusted suction-pressure regulating valve will aid in maintaining the humidity (up to 95 percent) that is needed to avoid fruit shrivel.

Regular inspection of the evaporator surfaces to ascertain adequate defrosting is made possible by means of strategically located mirrors or special windows. An evaporator is relatively easy to defrost when there is only four to six hours accumulation of frost, but once an evaporator is allowed to become plugged or frozen solid, many hours may be required to melt the ice. A frost-clogged evaporator may severely reduce the humidity in the storage room. This is especially true where multiple evaporators are used since

one evaporator may become clogged and cause the other evaporators to operate on too wide a temperature difference.

Auxiliary Equipment

Additional equipment required for the CA storage are: the gas analyzer for measuring the concentrations of carbon dioxide and oxygen of the room atmosphere, an absorber to remove carbon dioxide from the room, and a small air blower for adding air (oxygen) to the room. A typical arrangement of these items outside the CA room is shown in Fig. 5.

It is imperative that all devices operate satisfactorily. The gas analyzer should be checked frequently for leaks and adequate strength of the measuring solutions. Spare parts should be accessible in case of breakage so the unit can be repaired without losing control of the storage room. Daily removal of carbon dioxide from the storage room is essential since this gas is constantly produced by the apples. At present carbon dioxide is being removed by chemical reaction with a solution of caustic soda (NaOH) circulated through an absorption tower. For a detailed description of the operation of air absorber and the characteristics of carbon dioxide absorption, references 5 and 6 should be consulted. Several new types of absorption systems are in the developmental stage and it is anticipated that caustic-soda absorbers may be replaced by a more simple carbon-dioxide absorption system.

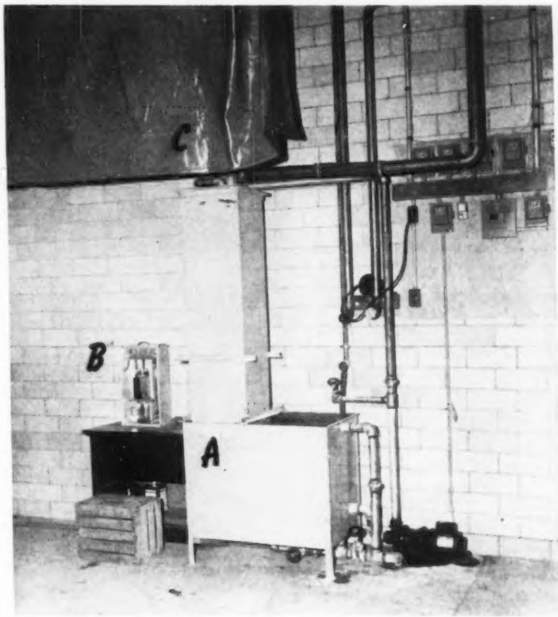
The addition of outside air to the room is a routine duty during the storage season to prevent the oxygen from being depleted below the critical 3 percent level needed for the fruit. Operators frequently overlook the need to vent the room in order to add air even though the porthole in the metal door is provided to serve this purpose.

Operating the CA Storage

The operation of a CA fruit storage is considerably more exacting than a regular storage. With the regular refrigerated storage short-time mechanical troubles may cause only minor changes in the fruit. For example, a refrigeration breakdown where a non-toxic refrigerant is used will have little effect other than a more rapid ripening of the fruit than would occur under normal refrigeration conditions. The grower can be away from his storage for several days at a time with little cause to worry. The controlled atmosphere storage operates under conditions infinitely more critical than the regular refrigerated storage. The oxygen level of 3 percent and the carbon dioxide level of 5 percent employed for the Jonathan and McIntosh varieties of apples are the minimum and maximum levels, respectively, that can be tolerated without damage. Constantly oxygen is consumed and carbon dioxide is produced by the natural respiration processes of the apples. Consequently there is a tendency to decrease the oxygen and increase the carbon dioxide in a CA storage to levels which will severely damage the apples beyond salvage within a few days.

The controlled-atmosphere storage requires daily care. The operator must analyze the gas in the storage at least once every 24 hours to determine the amounts of carbon dioxide to be removed and oxygen to be added. The quantities will vary from day to day depending upon the respirational activity of the fruit and the fluctuations in gas leakage due to changes in weather conditions, especially barometric pressure and wind.

Fig. 5 Auxiliary equipment: A, absorber; B, gas analyzer; C, breather bag



Temperatures should be closely observed and regulated, particularly to avoid the development of low temperatures in isolated non-observable areas of the CA storage room. Some apples, such as the McIntosh variety, are susceptible to carbon dioxide injury when subjected to temperatures below the recommended 38 F. Other varieties are stored at 32 F and can be readily injured by freezing should the temperature drop several degrees.

It is common practice to place a thermometer in front of the window of the metal door to enable the operator to determine the temperature at this point. One or more distant-reading thermometers, to ascertain the temperature within the stacks of fruit, are advisable. Growers with two or three controlled-atmosphere storage rooms sometimes use a temperature-indicating-potentiometer thermocouple system to determine the temperature at various locations in their rooms.

Summary

Controlled atmosphere storages for apples require refinements of regular storage techniques as well as special construction features and equipment. The storage building must be structurally sound, well insulated, and properly refrigerated. A gas seal is required to make the room sufficiently tight that the desired storage atmosphere can be developed and maintained. A carbon dioxide absorber, gas analyzer, and a small air blower are needed for determination and maintenance of the proper levels of carbon dioxide and oxygen.

Once properly constructed and equipped, the success of the CA storage is dependent upon exacting daily operational procedures. *(Continued on page 86)*

Land Forming and Smoothing for Efficient Production

T. W. Edminster
Member ASAE

Full agricultural production efficiency involves putting the land in shape—"land-conditioning"—for maximum effective operation

AGRICULTURAL engineers have a challenging responsibility as leaders in developing methods for increasing production efficiency in American agricultural programs. Full production efficiency, however, can not be achieved if we fail to consider the problems of putting the land itself into shape for maximum efficient and effective operation.

Essentially, this is the process of "land conditioning." It is a multiple approach to many problems. It is "land forming" for improved drainage and irrigation; it is "land smoothing" for high-speed, precision mechanization. It is fitting the field for the application of terraces, diversions, strip cropping, and contour row layouts, and it is a process of eliminating machinery hazards. "Land conditioning" is, then, the application of practices that make good farming, good conservation, and effective and efficient production work together under a modern program of mechanical agriculture.

In New England, the principles of land conditioning are really not new. We have only to drive through the countryside and observe the many stone fences to see a living example of the effort and forethought that were put into the preparation of these fields for effective agricultural use. Of course, with animal power the fields could be small. The problem of carrying stones any great distance resulted in the inefficient and difficult problem of stone piles and fences and small irregular-shaped fields. There are many other evidences of early "land conditioning" in the form of stone drains or pole drains, many of which are still working with a relative degree of effectiveness. We may find small, but carefully placed diversions, bed drains and other living examples of early efforts to improve drainage and thereby improve the productiveness of fields.

Paper presented at a meeting of the North Atlantic Section of the American Society of Agricultural Engineers at Ithaca, N. Y., August, 1956.

The author — T. W. EDMINSTER — is agricultural engineer, Eastern Soil and Water Management Branch (SWCRD-ARS), U.S. Department of Agriculture, Beltsville, Md.

Fig. 1 Rock rakes remove boulders with a minimum of soil removal and mixing. (Photo courtesy Soil Conservation Service)

If we think back, we recall other evidences of land conditioning and forming. For example, the old smoothing board, a two-by-twelve with a chain at each end to be pulled across the field by two horses, provided a low cost but effective means of knocking down the high spots and filling in the low ones. The drags, the birch brushes, the wood or cast iron roller, all are evidences of the farmer's appreciation that his fields must be level and smooth to provide adequate surface drainage.

As mechanization advanced, many of these practices seemed to be overlooked. The fields were plowed, disked and given a rough smoothing up with a spike-toothed harrow. Under this management, implement scars became deeper and more critical. Stone drains broke under heavier loads or clogged with sediment. Diversions, clogged with weeds and brush, lost their effectiveness in controlling surface runoff. Modern mechanization establishes many stringent requirements in terms of physical conditions if full efficiency is to be achieved. Fields must be relatively large and unobstructed; short rows, and odd-shaped fields result in much time lost in turning. Excessive numbers of headlands and turn rows result in wasted areas. Buried rocks and ledges increase implement damage and create serious safety hazards. Loose surface stones damage combine cylinders and corn pickers and increase the need for hand work in harvest operations. For example, an Aroostook County, Maine, farmer lowered his potato harvest costs from 45 cents per barrel to 22 cents by introducing machine picking, but an additional 10 cents reduction could have been realized if a rock picker had been used to remove the loose stones.

Smooth surfaces increase machine speeds. For example, C. H. Conover of the Hightstown Dairy in New Jersey estimates that their haying, grass-silage operations and pasture-clipping programs were speeded up 30 per cent on smooth fields as compared to those that had not received such attention. In addition to higher speed operation of equipment, he also pointed out that there had been much less machine damage and less operator fatigue.

Precision planting, cultivation, side-dressing and harvest all call for more uniform working conditions. When seed and fertilizer placement specifications call for seed depths of ¼ to ½-inch, and fertilizer banded 1 inch to the side or below the seed, good results can be expected only if implement scars, deadfurrows and other depressions are completely removed. Close, high-speed cultivation requires even plant spacing and positioning to be effective.

Fig. 2 *(Left)* The start of a "land conditioning" program. The gully, grown up to weeds and bush, is to be cleared, ditched and tiled before being filled. Fig. 3 *(Below)* The same field as in Fig. 2 after completion of "land conditioning" operation — gully drained, filled and smoothed to provide a field suited to high-speed mechanization. (Photos courtesy Soil Conservation Service)

The "conditioning" of land for more efficient production is also a part of land-use adjustment. By applying land clearing, stone removal, and intensive drainage practices, land having high production capability and low erosion hazard can be used to replace cropland unwanted for continued production.

Table 1 LAND-USE ADJUSTMENTS REPORTED BY SCS IN THE 13 NORTHEASTERN STATES, DECEMBER 31, 1954

Conversion	Practices applied SCS—1954	Remaining to be done
Cropland to grass	87,939 acres	3,998,850 acres
Cropland to woods	18,504 acres	1,117,859 acres
Grass and woods to crops	32,233 acres	1,528,658 acres

As shown in Table 1, SCS reports show that considerable progress is being made throughout the 13 northeastern states in making these land-use conversions. For example, in 1954 alone, 105,000 acres of land unsuited to crop production was converted to grass and woods. It is estimated, however, that nearly 5 million acres still remain to be taken out of crop production. Through application of sound conservation practices, 32,000 acres of woods and grass land were converted to crop production during 1954 with an estimated 1½ million acres still available for conversion.

In making these conversions in land use, land clearing has been an increasingly important practice. In 1954, in the Northeast over 38,000 acres were cleared. It is estimated that over 300,000 acres have been cleared in recent years and that 1⅓ million acres remain to be cleared. In many instances, these clearing operations do not necessarily bring new land into production but make existing fields more compatible to mechanized agriculture. Irregular-shaped fields are corrected, and grown-up fence rows, draws and other odd areas are eliminated to provide workable units.

Removal of field obstructions, i.e., rocks, stumps, spoil banks, etc., are another important phase of "land conditioning" for high-speed agricultural operations. In 1954, over 15,000 acres were improved in this way in the thirteen northeastern states. It is estimated by SCS that over 151,000 acres have been cleared of obstructions while the job remains to be done on an additional million acres.

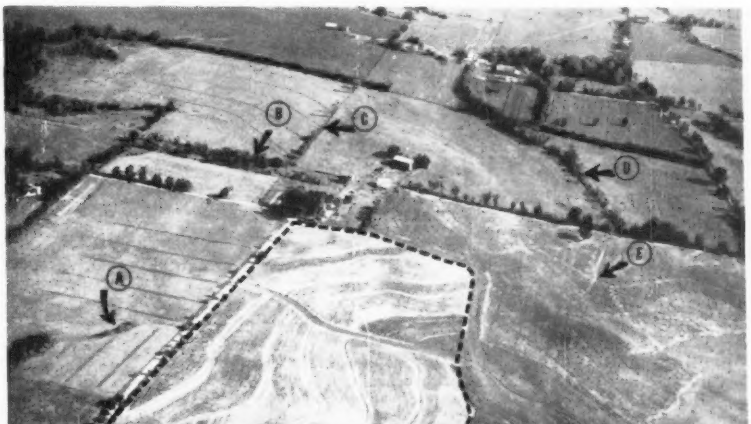


Fig. 4 *(Right)* Area outlined by dotted lines has been conditioned: Slopes smoothed, gullies drained and graded, waterways and strip cropping established. Arrows point to other steps that may be taken: (A) gully treatment, (B), (C), (D) small fields combined by clearing woods, fence rows, and gullies, and (E) rills and depressions that will contribute to gully formation to be smoothed. (Photo courtesy Soil Conservation Service)

. . . Land Forming and Smoothing

Based on the SCS figures on land conversion in the Northeast and on the trends in land clearing, there would be a net reduction to potential cropland in the Northeast of approximately 3½ million acres. Therefore, to sustain an economic balance of production in the Northeast more effective and efficient production methods must be applied to the cropland not involved in these land-use conversion aspects of land conditioning. Equally important, however, is the conditioning of the land from the standpoint of water management. This may be divided into several phases. Of first importance is the diversion of surface overflow from areas adjacent to important crop fields. These diversions must be carefully designed so that they have adequate capacity to prevent overlapping. They must be carefully located on the basis of detailed surveys to determine the most economical and effective position for maximum interception of overflow to assure effective interception of subsurface seepage. Cross-section design must be adjusted to provide for easy maintenance with a minimum of cost.

Diversions are becoming increasingly important throughout the Northeast. Over 480 miles of diversions were installed in 1954 and it is estimated by SCS that nearly 5,000 miles have been installed on Northeastern farms in recent years. It is further estimated that over 50,000 additional miles of diversions are necessary to bring under control surface and subsurface water that is now hindering effective crop production and efficient machine operation.

Related directly to the problem of diversion is the need for waterway development. The construction and maintenance of waterways to carry runoff water down slopes to safe outlets with a minimum of erosion hazard, and with a design that will permit ready crossing in farming operations, is an important aspect of "land conditioning." A considerable amount of work has been done in this direction. In recent years, nearly 21,000 acres of waterways have been developed, of which 1,500 acres were developed in 1954 alone. However, as shown in Table 2, it is estimated that 170,000 additional acres of waterways will be required to provide for the safe, orderly control of water needed in the northeastern states.

Table 2 MAJOR LAND-CONDITIONING PRACTICES APPLIED AND REMAINING TO BE APPLIED IN THE 13 NORTHEASTERN STATES (SCS Report, December 31, 1954)

Major land-conditioning practices	Practices Applied: SCS 1954 (calendar year)	Practices Applied: Now on land (all farms)	Needs remaining to be done
Land clearing	38,902 acres	369,757 acres	1,391,323 acres
Obstruction removal	15,570 acres	151,639 acres	874,740 acres
Diversion construction	489 miles	4,801 miles	50,032 miles
Waterway development	1,665 acres	20,996 acres	170,462 acres
Drainage	71,225 acres	574,096 acres	3,350,214 acres

One of the most general and critical problems of the Northeast is drainage. The flat coastal plain areas, the abundance of heavy, impermeable clays, the numerous lake bed and river plain areas all provide topographic and soil problems that make drainage a serious problem. It is estimated that over a half million acres of land in the Northeast have already been provided drainage. In 1954 alone, SCS reports showed 71,000 acres being drained. The remaining job to be done is estimated at nearly 3½ million acres.

Drainage, in terms of land conditioning, may be several things. It may be the installation of subsurface drains that will control the water table, intercept seepage flows or provide profile drainage. It may also be the application of modern surface ditches or drainage terraces. Designed with shallow flat cross sections these drainage structures provide both surface and interception drainage with minimum interference to equipment and farming operations. Land conditioning may also mean the simple grading and smoothing of the field surface to provide for ready movement of surface water. The elimination of depressions, deadfurrows, headlands and spoil banks and, in some instances, the development of a positive surface gradient adjust the surface of fields to provide good drainage. When combined with established waterways, diversions or other conveyance structures, management is facilitated and operating conditions are improved.

Land conditioning affects every farming operation. It provides for precision seeding, cultivating, side-dressing and harvesting; it permits the use of higher speeds with less crop damage and less implement wear; it makes possible the use of multiple-row equipment with each planter shoe at equal depths.

The efficiency of agricultural production is a direct function of the degree to which we apply our research knowledge, and to the degree to which we utilize our land, equipment and facilities.

"Land conditioning," through use of such practices as land clearing, obstacle removal, diversion and drainage system construction, and finally through land smoothing and grading to give uniform working conditions, facilitates the achievement of efficient production. Controlled drainage and water management, precision seed and fertilizer placement, uniform, clean and well-arranged fields all permit a degree of mechanized agriculture that results in maximum efficiency in operation and production.

. . . Apple Storage

(Continued from page 83)

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Shelling Attachment for Mounted Corn Picker

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Assoc. Member ASAE *Member ASAE*

Product design engineers review basic ideas and design procedures leading to improvements in the shelling function of a corn picker

DURING the past 20 years there has occurred a steady change in crop-harvesting and processing techniques. In 1938, for example, the final harvesting operation of most crops was completed in the barnyard, including threshing small grain, baling hay, chopping ensilage for silos, and shelling corn. New machines during this same period, however, such as the small combine, hay baler, hay chopper, and similar machines, have transferred the barnyard operations to the field to combine them with the primary harvesting processes.

This paper will deal with the transfer of one of the last barnyard operations (corn shelling) from the corn crib to the field.

Our company first began studying the feasibility of performing the shelling operation in the field in 1940. A number of shelling attachments were built for experimental purposes from 1940 to 1946. A few years later, development work was started on the corn head or row units for the self-propelled combine. Interest in field shelling increased quite rapidly after the first commercial corn head for the self-propelled combine was introduced in 1954. The development of suitable grain-drying equipment had to be accomplished before the farmer would readily accept field shelling.

Paper presented at the winter meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1958, on a program arranged by the Power and Machinery Division.

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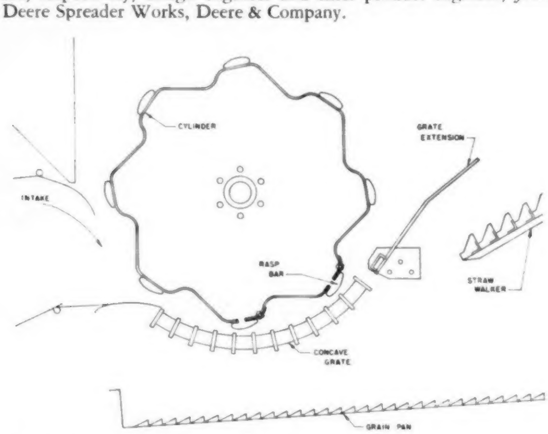


Fig. 1 *(Above)* Sectional drawing of combine cylinder

Fig. 2 *(Right)* Sectional drawing of No. 71 corn sheller

Field harvesting of shelled corn with a variety of picker-sheller combinations has demonstrated many of the advantages of harvesting corn, as follows:

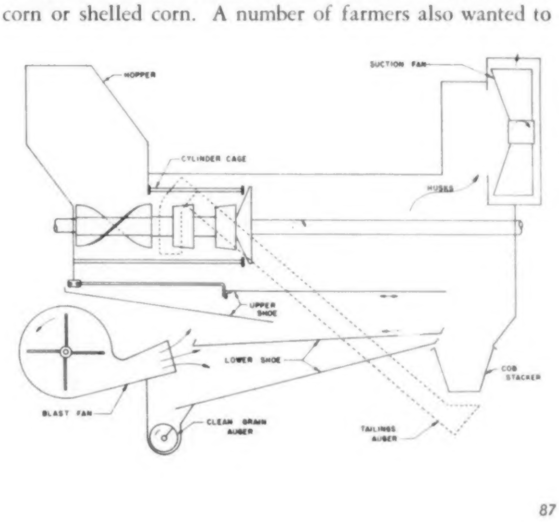
1 Corn can be harvested earlier resulting in *(a)* lower field losses due to fewer dropped ears, less butt shelling at the snapping rolls, and fewer losses caused by adverse weather; *(b)* more favorable working conditions during the harvest, and *(c)* longer pasturing season in the cornfield after the corn has been removed.

2 Harvesting, handling, processing and storage costs are substantially reduced: *(a)* Since shelled corn occupies one-half as much volume as ear corn, the labor to haul, elevate, and store the corn is reduced. Furthermore, about one-half the storage facilities are required. *(b)* Large labor crews are eliminated, as field operation is performed by one or two men, while five to eight men are required to operate a large stationary sheller.

3 Harvesting of large volumes of 25 to 35 percent moisture shelled corn is made feasible during the short period that the corn is available at that moisture level. This corn can be placed directly in an airtight storage bin, such as a vertical silo. It does not need to be dried, and can be fed quite automatically throughout the rest of the year.

4 The cobs and husks are left directly in the field, where all their value can be absorbed directly into the soil. In 60-bu corn, these cobs are equivalent to 50 lb of 5-0-5 fertilizer, and they add 600 lb of humus per acre.

Development of our company's first commercial corn head for the self-propelled combine met most of the requirements for field shelling. However, a large number of farmers had ear corn storage facilities still available, and wanted a combination unit that would harvest either ear corn or shelled corn. A number of farmers also wanted to



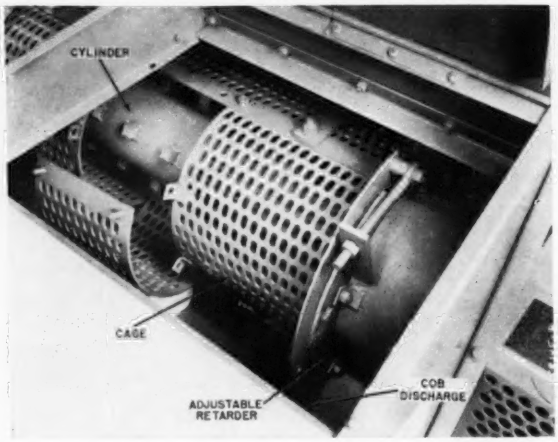
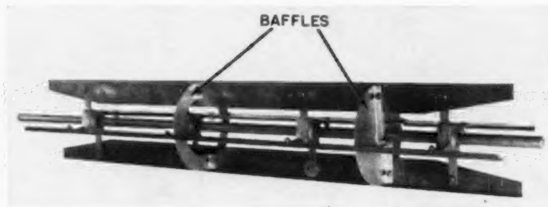


Fig. 3 *(Left)* No. 50 sheller cylinder, screen and adjustable retarder

Fig. 4 *(Below)* Fan showing placement of baffles



utilize the tractors and corn-picking equipment they already had to produce shelled corn with only the addition of a low-cost attachment.

In order to meet the requirements of these farmers, we developed the following specifications for a shelling attachment for a two-row mounted picker:

1 The shelling attachment should be interchangeable with the ear corn elevator of the No. 227 picker. The time required to change from harvesting ear corn to shelled corn, and *vice versa,* should not take over 45 min.

2 The capacity of the sheller should exceed the capacity of the picker in all conditions.

3 The sheller should produce corn clean enough to be sold as Grade 2 at any farm elevator in accordance with USDA standards for shelled corn; in other words, kernels damaged by cracking, heat, frost, etc., must not exceed 5 percent, and foreign material and cracked corn which will pass through a $\frac{3}{16}$-in round-hole sieve, together with the foreign material remaining on the sieve after screening, must not exceed 3 percent.

4 The sheller should handle corn with moisture content up to 35 percent.

5 The total corn losses from the air-cleaning system and the cob discharge should not exceed 1 percent.

6 Due to steep hills on which tractor and corn picker may operate, the sheller should not lose its efficiency when tilted up to 20 deg in any direction.

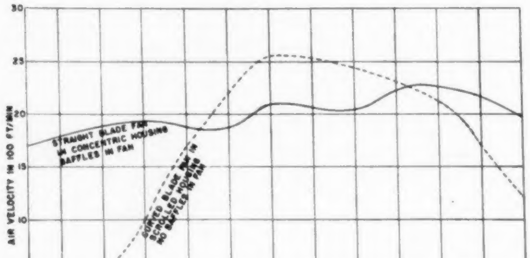


Fig. 5 Chart showing air velocities within windthroat

7 Horsepower requirements should be sufficient to provide power for operation of the corn picker and, if necessary, enough power also to tow 100 bu of shelled corn in a separate wagon on muddy ground.

8 The weight of the sheller should be kept as low as possible to preserve good balance on all four tractor wheels and to provide good stability on steep hills.

9 The sheller attachment should not adversely affect the maneuverability of the picker in the field. This is of special importance when making end turns, picking contoured lands, or picking around field obstacles. Sufficient ground clearance should be maintained for crossing corn rows, passing through ground swales, and transporting over deep-rutted country roads.

10 The shelling attachment should be as compact as possible.

Sheller Placement

The first design feature that had to be settled was to determine whether to use one main shelling and cleaning mechanism to handle the corn from both rows, or whether

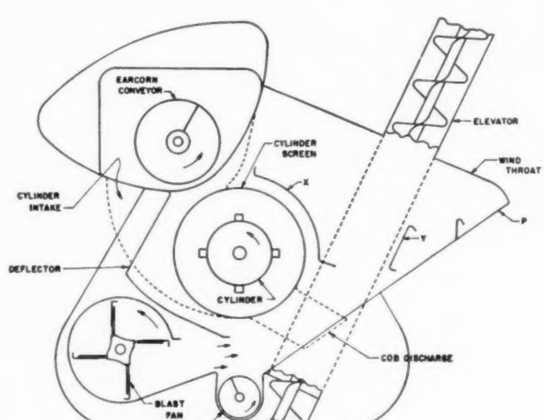


Fig. 6 Sectional drawing of the No. 50 sheller

Fig. 7 The No. 50 sheller in the field

separate shelling and cleaning devices should be provided for each row of corn. Specification 1 above eliminated the possibility of placing the shelling mechanism on the picker itself, directly behind the snapping rolls. Such an arrangement would move the center of gravity of the entire mechanism forward of the rear axle, but the requirement to produce both ear and shelled corn necessitated the placement of the shelling mechanism to the rear of the axle on the tractor. This still made it possible, however, to use two shelling mechanisms, one for each row. Specification 3, however, meant that as much space should be given to the cleaning and separation of the corn as possible, and it was decided to provide only one basic shelling unit and transport the corn from the right-hand row over to the left-hand side intake opening by means of a horizontal auger.

Sheller Type

The second step in this design was to determine which of the two basic present-day shelling mechanisms to use. All shellers made for custom and heavy-duty work use a rotating cylinder placed inside of a stationary cage. The corn and husks enter this chamber radially, and then pass circumferentially and longitudinally along the cylinder in the shelling process. The shelling is primarily a rubbing operation between ears of corn or cobs themselves, as well as the rubbing obtained against the outer cage and the inner rotating cylinder. In this operation, the ear or cob probably rotates around the circumference of the cage five to ten times before leaving the cob discharge end.

The second basic shelling mechanism consists of the combine type of rasp bar and concave where the ears enter the circumferential path of the rasp bars and travel only a portion of a circle between the rasp bar and the concaves (Fig. 1). All shelling must be done in a contact area of about 90 deg compared to over 1800 deg in the first-mentioned type of cylinder. The combine-type cylinder shells excellently except in very high moisture corn with a spongy cob. In these conditions, the rasp bar type of sheller splits some ears before the kernels are removed, and the kernels on the split cobs are lost because no shelling is done after the cobs leave the 90-deg cylinder.

In an effort to simplify the machine and to shell soft cobs, it was decided to use the first type of cylinder-shelling device.

Primary Separation

The third problem was to design the primary separating mechanism needed to separate the kernel from material larger in size than itself, consisting mostly of cobs and husks. The length of cylinder is tied in very closely with the design of the separating devices.

In the standard type of custom sheller used on American farms, the ear corn (with light husks) enters the feed opening or hopper (Fig. 2). The rubbing action in the cage separates the kernel from its attachment to the cob, and it is estimated that about 80 percent of the kernels manage to escape between the bars of the cage or through the slots in the screen that surrounds the cage. The remaining 20 precent plus all the cobs and husks are then discharged on an upper shoe or cob rack. This rack agitates back and forth at a speed of from 200 to 250 strokes per minute. As the cobs, kernels and husks bounce on the top of the upper shoe, a blast of air entering at the left-hand side and passing through the screens and into the shuck fan draws the husks into the airstream and out of the sheller. This is an important step to observe, as it is very difficult to remove a kernel of corn from inside of a large piece of husk by agitating it.

Thus, as the material reaches the end of the upper shoe, all of the cobs plus some husks and 1 to 2 percent of the shelled corn pass over the end of the upper shoe and are carried into the cob stacker. This shelled corn is removed from the cobs in the cob stacker by passing through a grate located in the bottom of the cob stacker. The tumbling action given to the cobs and kernels by the flights on the cob-stacker chain assist in this final separation. This corn is returned to the sheller with a tailings elevator.

On this field sheller, the above-mentioned primary separating process could not be satisfactorily duplicated. In the first place, it was highly desirable to remove the shuck fan, both from a power consumption viewpoint and from

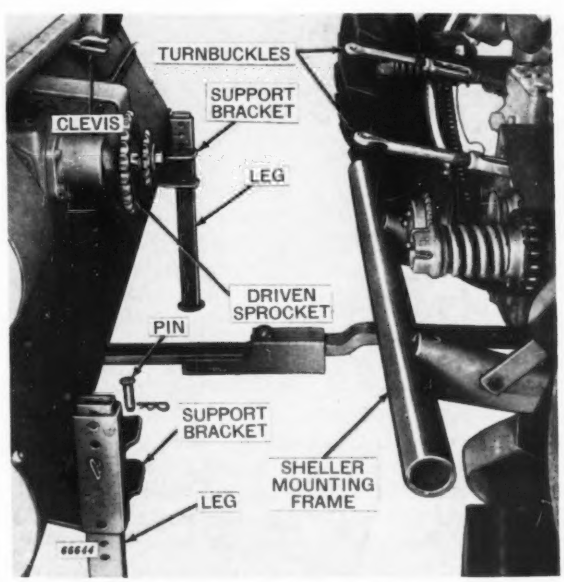


Fig. 8 Mounting the No. 50 sheller

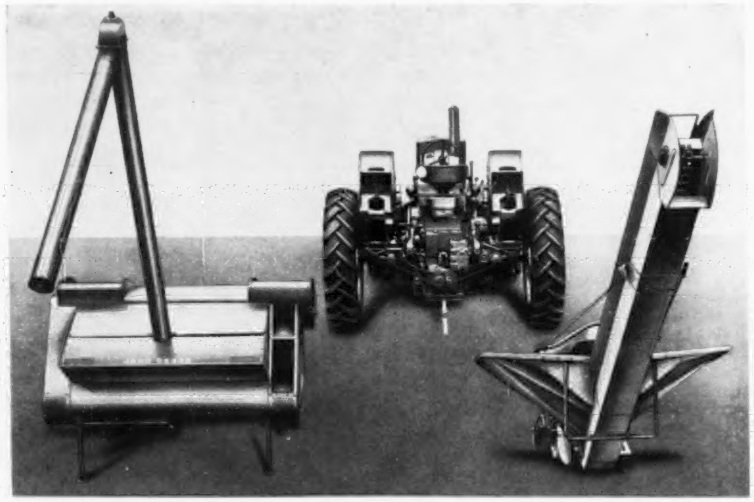


Fig. 9 Mounted No. 227 picker and attachments

space and cost limitations. This meant that a longer cylinder must be used in order to thoroughly shred the husks into small particles in which not a kernel of corn could hide. It was then decided to try to remove at least 99½ percent of the kernels from both the cobs and the husk while it still remained in the basic cylinder before it was discharged out of the cob door opening. If this could be done, it meant that no salvage would be required in the cob stacker, which would also save on space and cost.

Another important feature that had to be designed into the field sheller was to make it possible to operate on slopes of 20 deg in any direction. This meant that dumping cobs and kernels and shelled corn on shaking shoes was not too satisfactory, as the mass would run to one side or the other of the sheller without proper separation. It was therefore decided to keep the cobs, husks and kernels under power at all times to make certain that the corn and the material would be directed as desired without bunching, due to side-slope operation. All of these features also pointed to use of a long cylinder without shaking shoes.

It was therefore decided to perform all the shelling and primary separating operations in an extra long cylinder, 56 in. in length and 12 in. in diameter. The cylinder itself consists of a 6 in. diameter tube (Figure 3) with spiralled bars welded to it to force the material spirally through the cylinder cage. Lugs or knobs interspaced throughout the rest of the length of the cylinder remove and shred the husk and assist in completing the shelling cycle.

A perforated cage, with 7/16 x 3/4 in. slots completely covering the surface, was selected to enclose the 6 in. diameter cylinder. The slots do a more thorough job of primary separation than round rods, as the slots restrict the passage of small stalks, leaves and small pieces of cobs, while permitting the kernels to pass. This type of cylinder and cage was also chosen because it is light in weight, causes little damage to the kernel, and produces a gentle rubbing action between the ears, the cobs and the cylinder screen. The first field tests conducted on this machine in April, 1956, proved that this long cylinder would do both the shelling and separating operations.

The proper function of any shelling cylinder is dependent upon keeping it full. At the beginning of any shelling cycle, the shelled corn will ricochet through the length of the cylinder if no ears or cobs are present to obstruct its movement. By keeping the cylinder full, the material itself acts as a retarder, and it is estimated that, if the cylinder could be made long enough, all of the shelled corn would be dispelled through the periphery of the cage without any retarding, before it reaches the discharge end.

Even with a cylinder of this length, it was found necessary to develop the retarder or damper arrangement which would keep the cobs from working too rapidly toward the cob discharge end. These retarders are also used to regulate the pressure between the cobs, and to limit the cobs and kernel response to gravity while operating on hillsides.

Tests were conducted with retarders or angles of different sizes formed to fit circumferentially around the inside of the cage. These angles were first located in multiples of 90, 180, 270 and 360 deg arcs in various positions in the cage. Power requirements, however, precluded the use of retarders of this type. The separation percentage increased from about 97 percent to about 99½ percent when a complete circular retarder was placed just before the cob opening, in place of partial retarders. This meant that the shelled corn usually had to climb over this retarder to leave the sheller with the cobs. A further feature of this retarder was to make it adjustable, so that the height of the retarder could be varied due to operation conditions. Under average conditions it can be adjusted to keep corn losses both on and off the cob to less than 0.75 percent.

The cob discharge is located beneath the sheller, thus taking advantage of gravity and preventing the possibility of plugging the cylinder under any condition. On our first experimental model we attempted to throw the cobs out over the top of the windthroat. With this particular design, the cylinder would plug when shelling under adverse conditions.

Secondary Separation (Cleaning)

The fourth problem was to design the mechanism to separate the kernel from particles smaller in size than itself. Here again, the problem can best be explained by going back to the cylinder cage of the standard custom sheller (See Fig. 2). The 80 percent of the kernels which came

through the grate in the cage, and the additional 12 to 18 percent that are sorted out through the upper shoe, fall onto a lower shoe screen which has a small or different type of hole or slot. Here again, the movement of air through the machine assists in the cleaning. As the kernels fall from the upper shoe to the lower shoe, the blast of air removes the lightweight particles from between the kernels and carries them out with the shucks. On the lower shoe, agitation again takes place at the same speed as the upper shoe, which removes particles slightly longer or slightly lighter in weight than the regular kernel of corn. These foreign particles, called tailings, pass over the end of the lower shoe and into the cob stacker and receive the same treatment in the cob stacker as previously discussed above. The final cleaning of the corn is achieved by passing the corn over a screen in the bottom of the lower shoe in which the hole sizes are smaller than the kernel of corn to remove the dense particles of foreign material which are both heavier in specific gravity and smaller in size than a kernel of corn.

It was decided to eliminate both of the shaking shoes. The excellent design of the extra long cylinder, with its fairly smooth interior wall slots, eliminated the need for both shoes. By using an extra long blast fan the full length of the cylinder, it was found that many of the long slender tailings could be blown out of the sheller corn stream instead of having them shake out over the lower shoe. The windthroat is curved at the top to direct the dirt and trash toward the ground, away from the trailing wagon.

The shape of the small four-bladed fan (Fig. 4), is quite peculiar and presented some new problems. The inside diameter of the fan housing is only 10 in. while the length is 56 in. It might be questioned whether such a long, narrow fan would not have difficulty in supplying air to the middle of the blades for passage out through the center of the machine. Actually it proved to be the opposite, as once the air started to enter the intake openings at each end, it continued to travel from both ends until the two columns of air collided at the center and were thrown out between the blades in the center of the machine.

The broken line in Fig. 5 shows the air velocities taken in the windthroat through the entire length of the fan as it was first designed without any baffles or dividers. The solid line shows the air velocities of the fan across its length, indicating how the addition of baffles to restrict the passage of air along the center of the fan shaft caused the flow from the fan to become fairly uniform.

As in all cleaning processes by air, the maximum velocity is that which will carry foreign material from the stream of corn without actually carrying the corn along with the air so far that it will leave the cleaning chamber with the discharged air. With the irregular flows of air, the dimensions in the machine had to be adjusted to the maximum flow, which meant that all other areas in the machine received insufficient amounts of air for proper cleaning. After the baffles were placed as shown in Fig. 4, uniform cleaning was obtained across the length of the sheller and less than 0.25 percent of good usable corn was discharged with the air.

Both four-blade and six-blade fans were tested. It appeared that the addition of 50 percent more blades increased the flow of air only about 5 percent with this design. The six-blade design was therefore dropped.

The speed of the fan was varied 50 percent, from 1440 to 2200 rpm. It was found that sufficient air from a four-blade fan could be made available with a speed of about 1750 rpm.

To eliminate excessive ricocheting of the shelled kernels within the cleaning chamber, the shield *(X)* shown in Fig. 6, surrounds the shelling cylinder for about 60 deg. In addition, an adjustable baffle shown as *(Y)* acts as a retarder to deflect the kernels out of the path they would have to take to escape through the air discharge at point *P*. The placement of these deflectors had to be arranged carefully to avoid disturbing the flow of air through the downward stream of shelled corn.

Delivery to Wagon

The last major problem in the development of this machine was to deliver the clean shelled corn from the mounted sheller to a trailed wagon. The first device used was a corn thrower. This proved unsatisfactory for two reasons: first, the thrower would plug when a slowdown occurred, and the shelled corn above the thrower would fall back into the throwing chamber; and, second, sometimes the velocity of the corn leaving the spout was great enough to ricochet out of the wagon. The decision to use the inclined auger shown in Fig. 7 proved quite satisfactory after a combination of springs and swinging downspouts were designed to place the corn somewhere near the center of the wagon. These springs do an excellent job of positioning the downspouts in the wagon when harvesting contoured land or making turns at the end.

Mounting

The method of mounting and dismounting the sheller is best shown in Fig. 8. The four legs carry the sheller when dismounted, and are retractable up to avoid interference with cornstalks and other debris. The basic sheller is carried on a mounting frame as shown in Fig. 8 which fastens to the A frame of the picker mounting. The adjustable turnbuckles carry part of the weight by keeping the sheller pivoting about the mounting frame pipe. The turnbuckles are also used to align the drive chain between the sprockets on power-take-off shaft and the input sprocket on the gearbox, as well as to assist in raising the sheller from the mounting stand legs. The sheller can be removed and the ear corn elevator added to the basic picker in less than one hour (Fig. 9).

Transactions of the ASAE

THE deadline for ordering the second edition of the TRANSACTIONS of the ASAE to be issued by midyear 1959 is March 30. Since press run will be determined by advance orders, availability of copies cannot be guaranteed beyond closing date. The first edition, consisting of 96 pages, was mailed to all members of ASAE and subscribers of AGRICULTURAL ENGINEERING. The second edition will contain at least 128 pages of technical agricultural engineering papers and is being offered for $5.00 ($2.50 to ASAE members). To make sure you will receive the second edition send your order to ASAE, 420 Main St., St. Joseph, Mich.

. . . Hay Pelleting

(Continued from page 77)

Pressure-Density Relationships

The density of a pellet is closely related to the pressure applied to the raw material. In commercial pellet mills, instantaneous pressures have been measured up to 65,000 psi, which produce pellets with a density in bulk of 40 to 45 lb per cu ft, or up to 65 lb per cu ft actual density.

Data are not available from experimental machines making wafers, but some appear to be using rather low pressures, since bulk density ranges from 15 to 40 lb per cu ft. The low-density wafers are little better than baled hay for transportation or storage, and do not withstand handling well. Wafers having bulk densities of 25 lb per cu ft or higher seem to handle well, with little breakage. However, limited observations indicate that cows prefer wafers with densities under 25 lb per cu ft because they are easier to break up and consume.

Die Design

Although an important part of any pelleting machine, die design is a field in which little basic information is available. Manufacturers of pelleting machines have experimented with various designs, but this information has naturally been retained for their own use. Variables of diameter-to-length ratio, degree and direction of taper, round or polygon shape, and fabricating material are all important and interrelated. Experimentation in this field is slow and costly, and therefore often limited in scope.

Optimum Moisture Content for Pelleting

Commercial pelleting plants control moisture within the range of 12 to 16 percent at pelleting, usually by adding steam. Experimental work with various machines has not changed this as an optimum figure, but has extended the operating range to about 10 to 25 percent, wet basis. At 10 percent, operation of the machine is critical and capacity is reduced. Pellet temperature is likely to rise objectionably and the resulting pellet is likely to be too dense and hard. Moistures above about 18 percent are impractical in pelleting hay because fine grinding becomes difficult.

In wafering machines the results are much the same, except that the product at below 12 percent moisture content may not be dense enough to withstand normal handling. Results are best with hay at 15 to 20 percent moisture content. Little moisture is lost during the wafering process because of the low temperature (110 to 120 F) and elimination of grinding.

Attempts at pelleting or wafering hay of higher moisture have been discouraging. However, some machines have made wafers in the 30 to 40 percent moisture range. After forming, such hay must be dried for safe storage, although drying reduces the density and the material might not handle satisfactorily. The acceptability of this type of product has not been tested, but the possible advantages of operating at higher moisture content make further investigation worthwhile.

Safe Moisture Content for Storage

Information on safe moisture content for storage of pellets is completely lacking. Pelleted dehydrated alfalfa stored in inert gas in bulk tanks must have less than 9 percent moisture content for safe storage. No difficulty has been encountered in sacked and piled storage of ⅜-in. diameter pellets with moisture content up to 15 percent. Experiments are under way at Davis to determine the safe storage moisture content for small pellets in bulk bins, both sealed and unsealed. Large wafers have not been available in quantities sufficient to study this problem.

Machine Developments

Many farm and industrial machinery manufacturers are in the development stage with pellet mills.

SMALL PELLETS: Machines that will handle finely ground materials are readily available commerically. Emphasis is placed on developing force-feeding attachments to facilitate pelleting more coarsely ground hay. Experiments have been successful with up to ½-in. screen ground hay on pellets ⅜ to 1 in. in diameter, but with some loss in capacity. Some dairymen are testing this type of product in the hope that it will be satisfactory for dairy cows.

LARGE WAFERS: The greatest activity is in developing machines to make hay wafers. Numerous manufacturers have experimental machines making wafers 1½ to 4 in. in diameter and ½ to 1½ in. thick. Most of these are plunger-type machines. Applying the high pressure needed to make a wafer of suitable density creates terrific impact pressure at the forward end of the stroke. The frame of the machine must be very rugged, even in the comparatively low-capacity experimental machines. This, plus the heavy flywheel needed to smooth the pulsating load, results in a fairly heavy machine per ton per hour output. One commercially available machine requires about the same horsepower per unit of capacity and is as heavy as the standard ring-die pellet mill.

The principal known advantage of wafering machines is that they will handle long or chopped hay, instead of ground hay. This reduces the cost of processing prior to pelleting and places field pelleting in a more favorable position because less auxiliary equipment is needed. If an output of 5 to 6 tons per hour can be attained without excessive weight, field wafering will become a reality.

OTHER TYPES OF PELLETS: Other methods such as rollers and tapered screws have been or are being tried. The products are unlike die-formed pellets or wafers. Such machines have a continuous feed and output in contrast to the pulsating operation of the plunger-type machine. One such machine seems to operate best with high-moisture hay, between 30 and 40 percent. Although this development is in the early stages, it is of interest as a possible means of reducing field-curing time and increasing the nutrient value of the final product.

Economics of Feeding Pellets

Several reported experiments show that pelleted hay, as feed for meat animals, is worth 20 to 100 percent more than the same hay in baled form. The wide variation in reports indicates that many other factors in the feeding program affect the value that can be placed on pelleting. These reports are mainly based on tests with small pellets made from finely ground hay. In a recent experiment(7) at the University of California it was shown that the increased feed consumption and increased gain experienced with high-roughage pellets does not occur as liberal amounts of concentrate are incorporated in the pellet. Up to the present, a

value has not been placed on hay wafers for meat-animal use.

Experiments indicate that dairy animals will eat about the same amount of baled hay, wafers, or pellets made from ground hay. Dairymen who have fed pelleted hay have listed the following advantages:

(a) Self-feeding for reduced handling cost

(b) Reduction of hay inventory and insurance on hay

(c) Elimination of hay waste

(d) Guaranteed hay quality (dealer guarantees the protein level)

(e) Reduction in cost of manure handling (manure is drier and easier to handle).

Balanced against these advantages are the unknown factor of butterfat reduction, reports of wood chewing, and increased cost of feed.

Pelleting costs are not well established. In some cases, all-roughage pellets have been purchased for as little as $6 per ton more than baled hay. The average cost of custom grinding and pelleting is $10 to $12 per ton. Improved feeding efficiency and increased gains will not, in most cases, be great enough to pay this added cost. Most feeding experiments have been too short to warrant equipping for proper storage and handling of pellets. The situation is encouraging in many respects, but further studies are necessary before the economics of handling hay in pelleted or wafered form can be established.

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. . . Automatic Pilot

(Continued from page 79)

Wind blowing the corn to one side is not a problem because the feelers contact the stalks near the ground. The shape of the feelers provides adequate plant clearance for final cultivation. In the absence of guiding plants, the feelers hang straight down and guide the tractor straight ahead through a gap, staying on the row unless it is curved at that point.

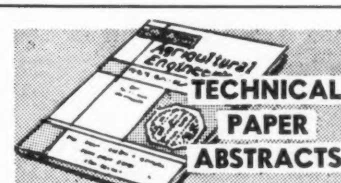
A windrow of hay, straw or grain can be followed if the feelers are widened to fit the windrow and set to run near the ground. The feelers must be offset considerably in this case and the support arm folded up for transport. Accuracy is less critical than in cultivating and speeds are usually lower. The use of automatic guiding allows the operator to spend most of his time watching the operation of the baler, forage harvester or combine as the case may be.

For plowing, the inner feeler is removed and a spring is used to hold the outer feeler against the furrow wall as shown in Fig. 3. With automatic guiding, a tricycle tractor is as convenient for plowing as a wide-front-axle tractor with the right front wheel running in the furrow. Some soil scientists recommend that the tractor not be run in the furrow because of subsoil compaction which cannot be removed by subsequent tillage. This is feasible with four or five-bottom plows, and automatic guiding would obviate the steering handicap.

A hinged shoe-type feeler can be used to follow a small trench such as left by a bull-tongue cultivator shovel. It may be possible to make a small trench between the rows when planting and use it for guiding the first cultivation when the plants are small.

It should be possible to guide from the edge of uncut grain or hay, thus extending the benefits of automatic guiding to mowing and direct forage harvesting and combining.

It is not anticipated that automatic guiding will eliminate the operator, although it might be possible with trouble-free operations in large fields adaptable to spiral rows. The primary benefit will be in taking over routine guiding in field operations, easing the strain on the operator and enabling him to pay more attention to the quality of the work being done.



Following are brief reviews of papers presented at ASAE meetings or other agricultural engineering papers of which complete copies are available. ASAE members may obtain copies of these papers without charge by returning order forms supplied upon payment of membership dues. Nonmembers, and members requesting more than 10 copies, may purchase papers at 50 cents each to cover carrying charges from the American Society of Agricultural Engineers, St. Joseph, Mich.

Application of Soil Fumigants, by E. F. Feichtmeir and Merrill L. Adams, respectively, manager, product application and superintendent of engineering, Shell Development Co., Agricultural Research Division, Modesto, Calif. Paper presented at the Winter Meeting of ASAE in Chicago, December 1958, on a program arranged by the Power and Machinery Division. Paper No. **58-613.**

A discussion of the physical properties of fumigants is presented in relation to requirements for their mechanical distribution in soil. The authors also describe new trends in soil pesticides which include application in dry granules and in irrigation water, each of which requires specially engineered applications.

Use of Strain Gages in Agriculture, by Gerald Lauderdale, Baldwin-Lima-Hamilton Corp., Electronics and Instrumentation Division, Waltham, Mass. Paper presented at the North Atlantic Section Meeting of ASAE in Newark, Del., August 1957. Paper No. **58-341.**

In this paper, the author surveys some of the uses to which the SR-4 strain gages are put in the field of agriculture. These uses range from pure experimental analysis on machine members to complex measurements of the behavior of the materials and machines as regards pressure, torque and load. He also touches on some newly developed uses of SR-4 transducers in the storage, handling and transport of farm products.

A Litter-Filter Ventilation System, by Warren L. Roller, instructor, Ohio Agricultural Experiment Station, Wooster. Paper presented at the Winter Meeting of ASAE in Chicago, December 1958, on a program arranged by the Farm Structures Division. Paper No. **58-712.**

This paper describes a test to determine possible advantage of ventilating a poultry house by pulling the air out through the litter. The litter-filter system involves air passing through a porous litter placed over some air conducting structure (which also

(Continued on page 109)

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New AE Building at Kansas State

A new agricultural engineering building providing new class room, laboratory and research facilities has been erected on the campus of Kansas State College. The new structure was built at a cost of $550,000 and provides a floor area of approximately 48,000 square feet. The building is essentially a three-story wing adjoining the school's engineering building and is considered to be a wing of "Seaton" Hall.

The design of the building is functional containing seven large laboratories, each occupying a floor area of 40 x 100 feet. The first floor contains the tractor lab, farm machinery lab, several classrooms, the general offices, and a conference room. The second floor contains additional office space and classrooms, an assembly room, student reading room, two laboratories equipped with drafting tables for farm structures and soil and water fields, and two labs for the electric power and processing area. The ground level contains a large hydraulics laboratory which is the hydraulics lab for the entire engineering school and is shared with the civil engineering department. This floor also contains two laboratories for instruction in the farm mechanics area as well as a storeroom for departmental supplies. The new building also has a small analytical laboratory, equipped with drying ovens, analytical balances, etc. for instructional and research purposes.

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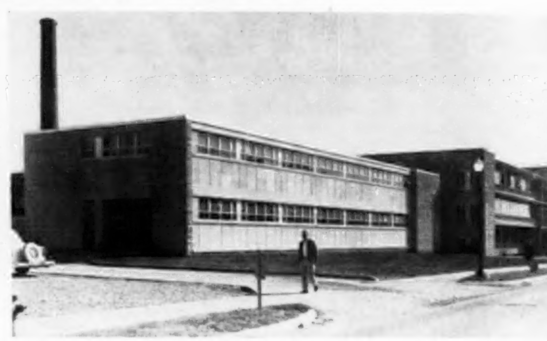

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Association with the farm equipment industry dates back to 1909 when he became employed by the Hart Parr Company. The following year he began work with the M. Rumely Company which later became the Advance Rumely Company, and in 1931 sold out to Allis-Chalmers Mfg. Co. He continued as an employee of Allis-Chalmers until 1933. While employed with the Advance Rumely Company as chief engineer, he supervised the designing of the Rumely combines and also the designing of several sizes and models of threshing machines.

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Connecticut Valley Section

The Connecticut Valley Section met December 10 to discuss the new developments in agricultural engineering with relation to industry. Addresses were given by Carl Libby, Northeast Agricultural Engineering Service; Ralph Howe, The Fafnir Bearing Co.; Roger Olcott, Walter Olcott Co.; Richard Campbell, Western Massachusetts Electric Co.; Howard Smith, Smith-Gates Corp.; and Harold Gulvin and Clifford Mellor, Eastern States Farmers Exchange.

Each speaker presented a brief picture of new products or services now being offered to the public by the company he represented.

Plans are being completed for a February 11 Section Meeting to be held at Publick House in Sturbridge, Mass. The evening speaker will be Maurice L. Burgener, manager, Farm Bureau, Portland Cement Association, who is scheduled to speak on new developments in farm buildings.

North Carolina Section

The North Carolina Section Winter Meeting is scheduled for March 6 to be held at the agricultural engineering building at North Carolina State College in Raleigh. An interesting program has been planned. Details may be obtained by writing to William T. Mills, N. C. ASAE Section Secretary, AE Department, North Carolina State College, Raleigh, N. C.

Mid-Central Section

The Mid-Central Section will meet April 3-4 at the Hotel Robidoux in St. Joseph, Mo. Registration will begin at 10:00 a.m. Friday, April 3. The first technical session is planned for 1:30 p.m. and will consist of two panel discussions, one on small watershed activities in the four states and another on the rural electrification programs. Dr. E. G. McKibben, president of ASAE and director of Agricultural Engineering Research Division, ARS, U.S. Department of Agriculture, has accepted an invitation to be the speaker for the Friday evening banquet.

A series of technical papers will follow the election of officers on Saturday morning. Presentation of the winning papers in the Section's Student Paper Contest will complete the morning program.

The final session will consist of a luncheon followed by the annual business meeting. Adjournment is scheduled for 1:30 p.m.

Michigan and Ohio Sections

The joint meeting of the Michigan and Ohio Sections will be held April 10 and 11. The group will tour the Enrico Fermi Atomic Power Plant in Monroe, Mich., Friday afternoon before the evening banquet to be held at the Secor Hotel in Toledo, Ohio. Dr. E. G. McKibben, president of ASAE and director, agricultural engineering research division, ARS, USDA, will be the banquet speaker. On Saturday morning the two sections will hold short business meetings to be followed by a technical session.

Michigan Section

The Michigan Section Winter Meeting will be held February 13 in Dearborn, beginning with a tour of the recently completed Massey-Ferguson tractor plant. The technical session will be at the Dearborn Inn. Papers to be presented will include talks on differential locks in tractor transmissions, by M. Lynne Geiger, Ford Tractor and Implement Division, and C. L. Baker of Massey-Ferguson; a presentation on heavy equipment in agriculture, by Howard Haynes, Caterpillar Tractor Co.; an analysis of the properties of the alfalfa plant to determine how the plant loses moisture during the drying process after cutting, to be presented from a paper by Tom Pedersen and W. F. Buchele, and a discussion on visions in engineering education, by J. D. Ryder, dean of engineering, Michigan State University.

H. G. Klemm, vice-president of engineering, Massey-Ferguson Inc., will be speaker for the dinner to follow the technical session. Massey-Ferguson Inc. will act as host for the meeting.

Quad City Section

The Quad City Section met January 9 at the American Legion Hall in Moline, Ill. with 250 guests and members in attendance.

F. W. Andrews, University of Illinois, discussed mechanical farm feed handling in which he presented a need for complete package systems for the many farmers who wish to mechanize but who find they must rely on much of their own handiwork. He presented a challenge for manufacturers to produce an engineering system which could be purchased and assembled according to a predetermined plan with a minimum of modification.

G. T. French, vice-president of Deere & Co., Moline, Ill., spoke on management's viewpoint on engineering, dealing with some of the considerations involved in the formulation of product engineering programs and some of the methods used in making the management decisions involved in placing proposed new products on the market. He also considered the relationships between product engineering and some of the other major staff elements in the management organization.

As additional activity, a technical series of meetings were held on January 23 and 30 and February 6. The two papers presented on January 23 were on hydraulic systems controls, and application of hydraulic motors directly to low-speed shafts, given by B. F. Vogelaar, John Deere Harvester Works and D. F. Morgan, Char-Lynn Co., respectively. On January 30 presentations on photography as a research and development tool were given by William Gleaves, Watlin Inc.; Robert Barnick, IH McCormick Works; Vern Daling, IH Harvester Works, and Fred Wise, Deere & Co. The meeting held February 6 featured R. L. Witsche, general supervisor, mechanical engineering research, IH Manufacturing Research, who addressed the group on product design and its effect on tooling.

Iowa Section

The Iowa Section will hold a dinner meeting in conjunction with the Agricultural Section of the Iowa Engineering Society, the evening of February 24 at the Ft. Des Moines Hotel, Des Moines. ASAE members are invited to attend any of the sessions of the Iowa Engineering Society's meeting, which begins the morning of February 24 and concludes with the annual banquet the evening of the 25th. The theme of this meeting is "The Engineer and Iowa's Industrial Future."

Lloyd Hurlbut, chairman, agricultural engineering dept., University of Nebraska and vice-president of ASAE, will speak in the afternoon of the 24th on agriculture as an industry. He will also give a short informal talk at the evening dinner meeting. Dr. George Town who will be the Iowa State College Dean of Engineering effective March 1, will also speak during the evening program.

ASAE MEETINGS CALENDAR

February 13 — MICHIGAN SECTION, Massey-Ferguson, Inc., 12601 Southfield Rd., Detroit, Mich.

February 24 — Joint meeting of the IOWA SECTION and the Agricultural Section of the Iowa Engineering Society, Wedgewood Room, Ft. Des Moines Hotel, Des Moines.

March 6 — North Carolina Section, North Carolina State College, Raleigh, N. C.

March 12-13 — SOUTHWEST SECTION, Dallas, Texas.

April 3-4 — MID-CENTRAL SECTION, Hotel Robidoux, St. Joseph, Mo.

April 10 — Joint meeting of the IOWA SECTION, Iowa Section of the American Society of Mechanical Engineers and the Waterloo Technical Society, John Deere Waterloo Tractor Works, Waterloo, Ia.

April 10-11 — Joint meeting of the Michigan and Ohio Sections, Secor Hotel, Toledo, Ohio.

April 16-18 — FLORIDA SECTION, George Washington Hotel, West Palm Beach, Fla.

April 23-24 — ALABAMA SECTION, Anniston, Ala.

JUNE 21-24 — 52ND ANNUAL MEETING, Cornell University, Ithaca, N. Y.

September 1-3 — NORTH ATLANTIC SECTION, University of Maryland, College Park, Md.

October 21-22 — Alabama Section, Enterprise, Ala.

December 16-18 — WINTER MEETING, Palmer House, Chicago, Ill.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.

BULLETIN

The first response to the action taken by the Motion Picture Finance Committee during the Winter Meeting (see page 15, January issue) reached ASAE Headquarters just before press time.

A check amounting to $171.88 has been received from the Quad City Section of ASAE as the first installment toward its quota for the Motion Picture fund. The amount of the check represents the profit from a raffle of a radio which was conducted by the Section as its first fund-raising project in behalf of the ASAE motion picture. Other similar projects are being planned by the Section. As a source of ideas for others, Sections are urged to report to ASAE Headquarters any fund-raising procedures being used.

Also, in pledging support to the quota set up for colleges, the first commitments for purchasing copies of the film were made by the University of Arkansas and the University of Illinois.

NATIONAL OIL SEAL LOGBOOK

Ask yourself these questions when specifying oil seals

SHAFT RPM, FPM, RUNOUT, ENDPLAY	Is seal rated at or above my anticipated operating extremes? ☐ YES ☐ NO
TEMPERATURE, LUBRICANT TYPES	Will heat or special-purpose lubricants attack my sealing lip compounds? ☐ YES ☐ NO
PRESENCE OF DIRT OR OTHER FOREIGN MATERIAL	Point often overlooked. If present, should I specify dual-lip sealing member? ☐ YES ☐ NO
COST RELATED TO SEAL DESIGN	Will a simpler, less expensive seal do as good a job as a more sophisticated unit? ☐ YES ☐ NO
NEW SEAL DESIGNS AND MATERIALS ON MARKET	Are there new high temperature, high speed compounds I should examine before specifying? ☐ YES ☐ NO
SPECIAL DESIGNS FOR SPECIAL PROBLEMS	Not all sealing jobs can be met with stock seals. Do I need a special factory design? ☐ YES ☐ NO
DELIVERY, REPUTATION FOR QUALITY	Is my resource noted for on-time delivery, uniform quality, and good follow-up service? ☐ YES ☐ NO

Don't specify "blind." Your National Oil Seal Engineer has up-to-date data on seals—old, new and under development. He understands current sealing parameters; what special designs can probably be developed. His frank, free counsel can't help but lead to better sealing, faster assembly, simpler servicing, faster delivery or lower cost.

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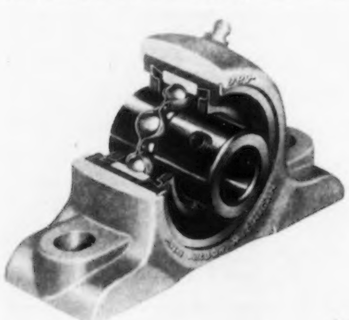
Van Wert, Ohio

"Sound-Conditioned" Pillow-Block Bearings

Hoover Ball & Bearing Co., 5400 South State Rd., Ann Arbor, Mich., announces a new pillow-block ball bearing that is de-



scribed as "sound-conditioned" and designed for applications where extremely quiet operation is desired. These bearings incorporate a synthetic rubber cushion between the bearing's outer ring and the pillow-block housing, to insulate against vibration and dampen noise. The housings for these pillow blocks are of a lightweight, ductile material that resists shock and vibration. The units are available in five shaft sizes from ½ through 1 in. Offered as a separate unit is the component simplex machine unit bearing of these pillow blocks. It consists of a prelubricated, single-row bearing with large balls and deep raceways, plus two seals and a wire lock ring for use in mounting. Outer diameter of the bearing is enclosed with a synthetic rubber cushion.

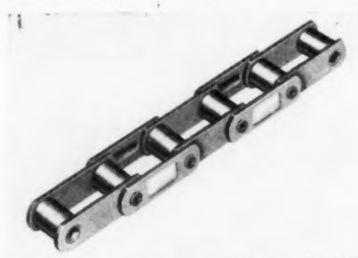
Crop-Drying Wagon

New Holland Machine Co., New Holland, Pa., announces a new crop-drying

wagon with three-way flexibility for hay and grain drying and hauling operations. Three variations for crop drying are provided by this wagon, namely, a wagon bed for regular hauling, a crop-drying wagon with sides 3 ft high and solid swinging doors, and the addition of a set of 2-ft extension sides and swinging doors for the ends, the latter variation allowing for handling hay loads five bales deep. The wagon has corrugated metal sides, and a slatted metal floor is provided for hay drying. A perforated grain floor is available which slides into place over the hay floor. To insure an airtight seal and fast attaching, the wagon has clamps for a canvas hood set all around the top. Air flows from the top of the wagon down with no condensation problems. The slatted floor lets moisture-laden air escape at the bottom. This is said to give uniform penetration of air for economical drying.

Conveyor Roller Chain Improvement

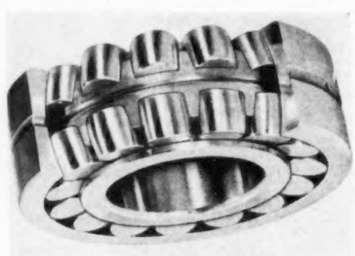
Chain Belt Co., Agricultural Chain Div., Dolton, Ill., announces a new feature in the design of its straight side-bar, conveyor-type roller chain. This type chain is now manufactured with connecting side plates that are stamped with an embossed surface

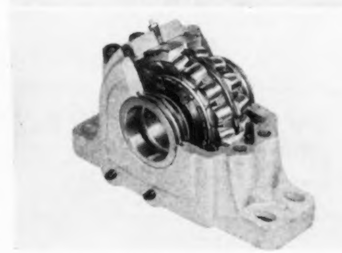


to provide protection to rivet heads, thereby resulting in a better-wearing, longer-life chain. The embossed side-plate feature was developed especially for agricultural chains which slide on their sides in operation or which are exposed to excessive rivet-head wear from walls in narrow troughs. Due to the embossed surface, the rivet heads are protected from premature wear, especially in applications where chains operate under abrasive conditions.

Spherical Roller Bearings

Link-Belt Co., Prudential Plaza, Chicago 1, Ill., announces that three major design improvements have been combined in its new high-capacity, self-aligning, spherical roller bearing. The new features include



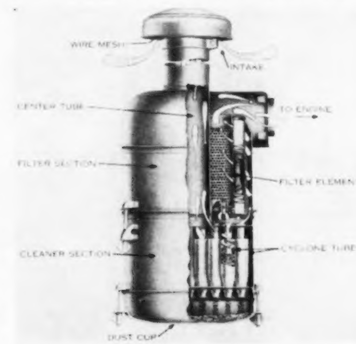


maximum diameter and quantity of convex rollers for each bearing size, precision-machined centrifugally-cast bronze retainers, and high, heavy inner-race shoulders. These new spherical bearings are being introduced initially in series 22200 and 22300, in bore sizes ranging from 1.5748 to 11.0236 in. with dynamic load ratings up to 288,000 lb. These bearings will also be available in pillow blocks in bore sizes ranging from 1$\frac{7}{16}$ to 10 in. Centrifugally-cast bronze retainers are said to provide smooth, quiet bearing performance even under extreme speeds and loads.

The company's new book No. 2760 describes this new line of self-aligning spherical roller bearings.

Dry-Type Air Cleaner

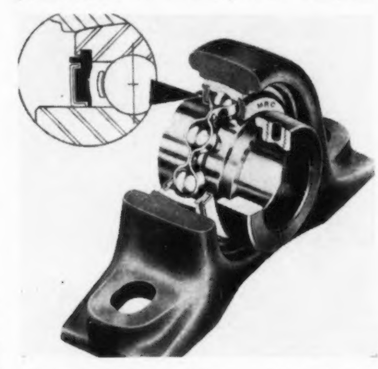
Caterpillar Tractor Co., Peoria, Ill., announces a new dry-type air cleaner developed especially for Cat DW20 and DW21 tractors. The cleaner unit is made up of a disposable resin-impregnated cellulose filter, multicyclone precleaner, aluminum center tube, housing and collecting tray. In operation air is drawn through the stack cap, passes downward through the aluminum center tube and enters the precleaner which is made up of two aluminum spirals and a



group of vertical, funnel-shaped nylon tubes. As air enters the spirals, it begins to swirl, setting up centrifugal action. The dirt particles, being heavier than air, are reportedly forced to drop out of the nylon tubes into the collecting tray. The manufacturer reports that about 95 percent of the dirt particles are removed at this point. Air then travels upward through small aluminum tubes set inside nylon funnel sections to the resin-impregnated cellulose filter element. According to the report, this element removes the remainder of the dirt and the clean air is directed into the intake manifold of the engine.

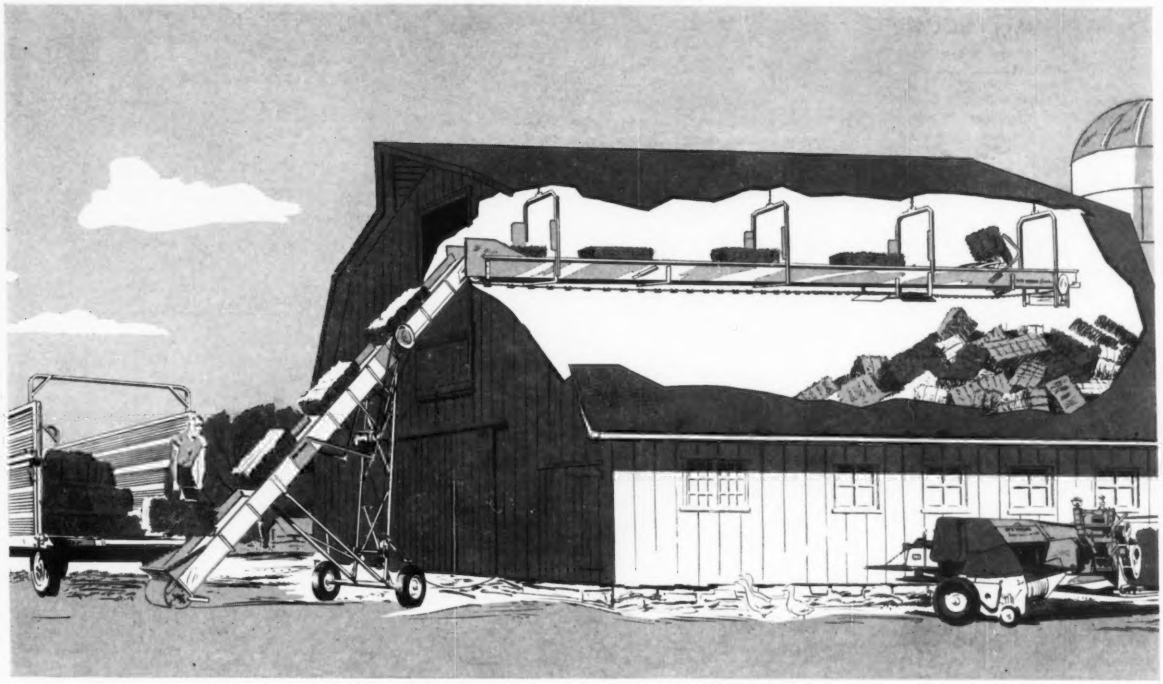
Permanently Lubricated Pillow Blocks

Marlin-Rockwell Corp., Jamestown, N.Y., has introduced a new line of permanently lubricated pillow blocks. The ball bearings used in these pillow blocks are said to be prelubricated at assembly with sufficient



grease to eliminate further need of lubrication. The lubrication is retained in the bearings by seal which combines the advantages of a rotating flinger, labyrinth seal and positive-contact synthetic rubber seal. This new pillow block reportedly permits the bearing to adjust to shaft misalignment and still maintain full contact seating of the bearing in the housing. It fits standard-inch shaft dimensions and is interchangeable with most other types of pillow-block installations. Positive locking on the

(Continued on page 100)



FOR HAY: "*155*" *Elevator* can be loaded directly from the drying wagon. Exclusive 60° elevation means the "155" costs least per foot of actual elevating reach.

"*160*" *Mow Conveyor* receives bales from elevator, discharges them at any 12′ interval. As mow is filled, bale discharge unit is easily moved to next discharge station.

These complete crop-handling systems speed work, save labor

Modern progressive farmers have discovered New Holland's flexible system of farm-engineered equipment makes manual crop handling as obsolete as the pitchfork.

Crop bottlenecks, backbreaking labor, and time-wasting field-to-storage transport have been displaced by modern crop-handling methods that spell greater profits and faster, easier work.

With the addition of the Smoker line, New Holland now offers a complete selection of elevators, mow conveyors, bale boosters, corn drags, corn and grain boxes, and field bale loaders.

Your local New Holland dealer can give you full details on the New Holland Smoker Line. Or write New Holland Machine Company Division of Sperry Rand, New Holland, Pennsylvania.

NH NEW HOLLAND *"First in Grassland Farming"*

FOR CORN: Mechanized corn and grain handling saves at least 75% of unloading time. Here, "140" Elevator is teamed with Self-Powered "122" Corn Drag.

FOR SILAGE: "336" Spreader with Forage Box, and "22" Forage Blower store 48 tons per hour! With cross-conveyor attachment, Spreader with Box is Automatic Bunk Feeder.

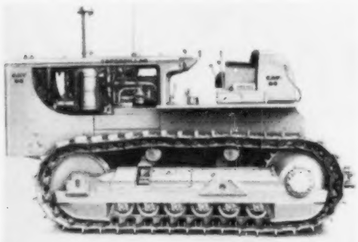
. . . New Products

(Continued from page 98)

shaft is accomplished by a cam-action locking collar which engages an eccentric land on the bearing inner ring. After the collar is positioned and setscrew is tightened on the shaft, the locking collar becomes tighter as the shaft rotates. This pillow block is available in all standard shaft sizes up to $1^{15}/_{16}$ in.

Two New Tractors

Caterpillar Tractor Co., Peoria, Ill., announces two new tractors having increased weight and horsepower. They are known as



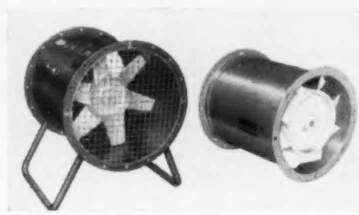
the Caterpillar series H D8 direct-drive and torque-converter tractors. By use of double-reduction, final-drive gearing, ground clearance of nearly 20 in. is provided on the new units. The manufacturer reports that flywheel horsepower of the new units has been increased from 191 to 225, drawbar horsepower on the direct-drive model has been increased from 155 to 180, and torque rise of the new engines has been increased to 20 percent. The increased engine horsepower has resulted primarily from the addition of a turbo-charger to the D8 engine. Its introduction makes available two turbocharged, track-type tractors in the Caterpillar line. Many design features to facilitate operator comfort and visibility have been included in the new tractors.

Hose Assembly Line

Parker Fittings & Hose Div., Parker-Hannifin Corp., 17325 Euclid Ave., Cleveland 12, Ohio, announces a new line of hose assemblies with permanently attached ends to complement the company's line of reusable fittings and industrial hose. Known as the "Krimp-lok" line, various types of industrial hose are offered to meet a range of requirements. Featured are wire-inserted woven rayon, rayon braid, steel wire single and double braid, and steel wire spiral reinforced hose for low, medium and high-pressure hydraulic and pneumatic applications. Descriptive bulletin 4501 is available on request.

Pressure-Type Agricultural Fans

Propellair Division, Robbins & Myers, Inc., Agricultural Dept., Springfield, Ohio, has developed a new line of pressure-type tubeaxial fans for grain aeration and crop drying suitable for positive air moving in bins, driers, or buildings. They are equipped with matched-design motors and propellers



and are available with propeller diameters of 8, 12, 16, 20, and 24 in. Propellers are cast of magnesium-aluminum alloy said to be spark-proof and non-shattering and to have the latest airfoil designs to provide maximum efficiency over the operating pressure range. The fan bodies are compact tubeaxial drums of heavy-gage rolled steel. Sizes above 8 in. are equipped with mounting flanges. Wire mesh guards, legs, venturi inlets, and similar accessories are available as optional features.

Herringbone Milking Stall

James Mfg. Co., Fort Atkinson, Wis., announces a new herringbone milking stall featuring metered feed flow and galvanized

steel construction. The feed meter in the hopper is operated by a handle in the pit. One full stroke delivers 4 lb into the center of the removable feed pan. For easy cleaning the herringbone stall manger hangs from wall brackets which eliminates any connection to the floor. Automatic feeding into the manger is also available.

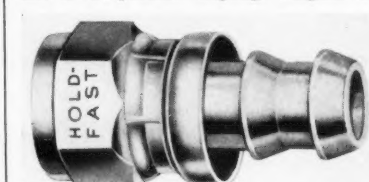
Flail-Type Harvester

J. I. Case Co., Racine, Wis., announces its model 640 flail-type utility harvester designed to cut a 60-in. swath with a 2-plow

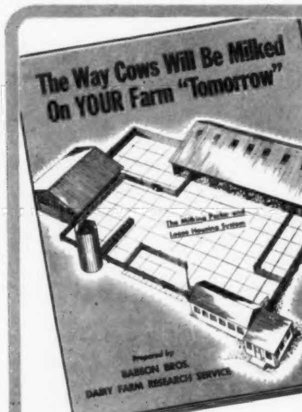
tractor for power. The rotor has 24 right-hand and 8 left-hand knives; the chopper fan has 3 blades and 3 knives. A cross auger feeds material from rotor to fan. A cross auger door is accessible for by-passing the fan when chopping stalks. A fully rotating spout permits front, side or rear delivery and can be locked in position. The discharge spout position is adjusted by a rope from the tractor seat.

Reusable Coupling Assembly

Anchor Coupling Co., Inc., 342 N. 4th St., Libertyville, Ill., has introduced a new line of low-pressure couplings designed for



general, low-pressure, hydraulic and fluid transfer service. Attachment and removal of the hose is quickly and easily accomplished without the use of tools. They are available in a wide range of styles and sizes, and are said to include couplings suitable for practically all general, low-pressure applications. Assembly is quick and uncomplicated since the hose is simply forced over the stem until it seats against the bottom of the protective cap. Complementing these new couplings, the company has introduced two new styles of low-pressure, 1-cotton braid hose.



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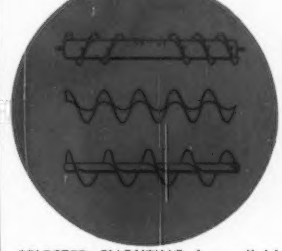

SELECTED FLIGHTING is available from Link-Belt for every auger need — helicoid, cut flight, short pitch, ribbon flight, double flight and many others — in the metal and finish best suited for your design.

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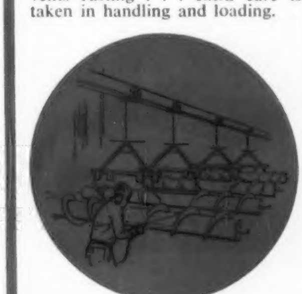

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NEW BOOKS

Toward Responsible Government, by Edward F. Renshaw. 6 x 9 inches, xii + 164 pages, indexed. Published by Idyia Press, 8342 So. Kenwood, Chicago 19, Ill.

The author considers the past contribution to water resource programs in relation to what he believes should be the proper role of the federal government in promoting the best use of our limited resources. Part I deals with an economic appraisal of federal investment in water resource programs and Part II is an economical appraisal of federal investment in reclamation.

Compilation of ASTM Standards on Plastics. Paper cover, 6 x 9 inches, 1108 pages. May be obtained by writing Albert L. Batik, Development, American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $8.00.

This edition contains 191 ASTM standards applicable to the plastic industry, including 43 standards, not appearing in the 1957 edition, and a group of standards on plastic pipe with specifications covering dimensions of SWP and IPS sizes for cellulose acetate butyrate, and acrylonitrile-butadiene-styrene pipe. Also included are methods for short- and long-term hydrostatic pressure tests of plastic pipe. These pipe standards have been developed jointly by the ASTM and by the Society of the Plastics Industry. It also contains tentative abbreviations of terms relating to plastics.

Effect of Ozone On Rubber. Hard cover, 6 x 9 inches, 134 pages. For copies write to Albert L. Batik, Development, American Society for Testing materials, 1916 Race St., Philadelphia 3, Pa. $3.75.

This book covers several facets of the effect of ozone on rubber. It is of particular interest to rubber technicians, engineers and scientists concerned with the application of rubber products in instances where ozone produces a problem. Included are discussions on rubber and its environment, a study of the action of ozone with polybutadiene rubbers, the reaction of ozone with rubber, ozone resistance of elastomeric vulcanizates, chemical antiozonants and factors affecting their utility, prevention of ozone attack on rubber by use of waxes, comparison of accelerated and natural tests for ozone resistance of elastomers and, quantitative measurement of rate of ozone cracking. It also has a report on interlaboratory ozone tests program of ASTM Committee D-11, Subcommittee XV, 1957.

Arc Welding Lessons for School and Farm Shop, by Harold L. Kugler. Cloth. 6 x 7¾ inches, xi + 343 pages. Illustrated and indexed. Published by The James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio. $1.00 in U.S.A. $1.50 elsewhere.

The material included in this book has been written in response to a demand for a text to instruct welding operators in vocational and rural farm shops in the use of arc welding equipment to arc weld, hard face, cut, and use the carbon arc torch. Part I includes seven informational lessons, Part II, operations to develop skill in using arc welding equipment and Part III, arc welded projects.

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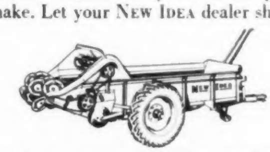

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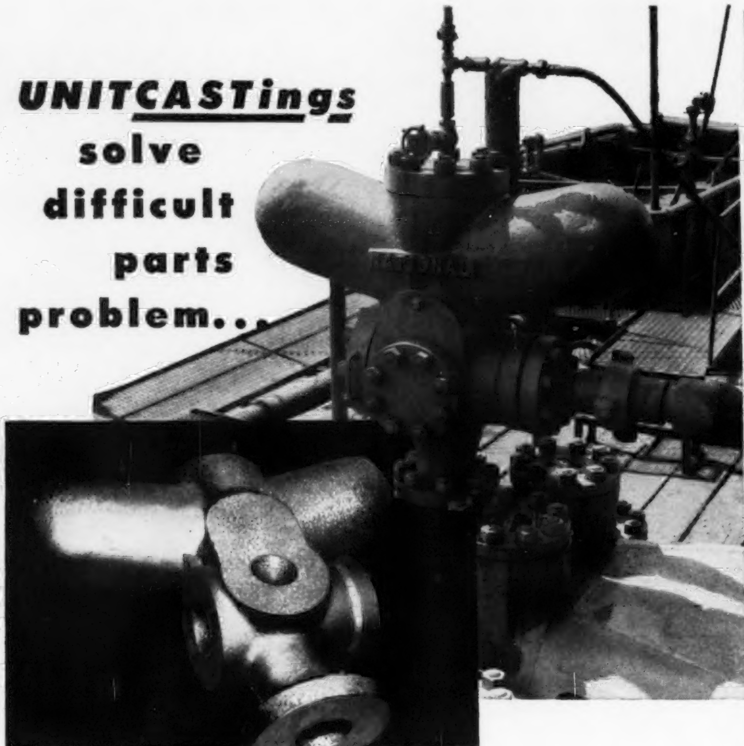

Foundry Engineering aids product development!

This steel casting is another example of Unitcast's ability to cope with unusual problems. As the main body of a new-type Pulsation Dampener for The National Supply Company's oil field equipment, this casting had many tough end-use requirements. Basically, the part had to absorb shock, withstand corrosion, and hold hydrostatic test pressures up to 8,000 psi. The fewer the components in the part, the better the durability.

The ideal solution, a one-piece steel casting, required accurate suspension of a huge core on a minimum number of points to produce a horizontal "tank" within consistent tolerances. One subsequent finishing problem involved economically "sealing" the core suspension holes by a method that would hold up in end use—*plus* pass radiographic inspection!

Once again, Unitcast foundry engineering has helped a customer develop a new product for their well-known line. Why not call in Unitcast engineers on your product-development problems? Write today!

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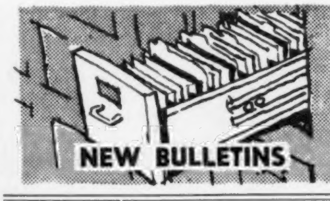

The following bulletins have been released recently. Copies may be obtained by writing to author or institution listed with each.

Concentrate Metering for Dairy Cows in Stanchions and Milking Parlors, by E. C. *Schneider.* Bulletin 609, September 1958. Agricultural Experiment Station, University of Vermont and State Agricultural College, Burlington, Vt.

Ventilating Poultry Houses with Fans, Extension Bulletin 529, June 1958. Extension Service, State College of Washington, Pullman, Wash.

Agricultural and Horticultural Engineering Abstracts, Vol. IX, No. 3, 1958, Abstracts 928-1316, National Institute of Agricultural Engineering, Wrest Park, Silsoe, Bedfordshire, England.

Farm Power Sprayers, PNW Bulletin No. 23, September 1958, University of Idaho Agricultural Extension Service, Moscow, Ida.

Farmstead Rearrangement, by Ralph Ricketts, Circular 673, March 1958, University of Missouri, Agricultural Extension Service, Columbia, Mo.

Home Heating with Electricity, by Richard L. Witz, Richard W. Guest and Ernest W. French, Bulletin No. 420, September 1958, Agricultural Engineering Department, Agricultural Experiment Station, North Dakota Agricultural College, Fargo, N. D.

Good Fences for Your Farm, by Carl N. Schenemen and Albert R. Hagan, Circular 667, June 1956, University of Missouri, College of Agriculture, Agricultural Extension Service, Columbia, Mo.

The Auger Hole Method, a field measurement of the hydraulic conductivity of soil below the watertable, Bulletin 1, 1958, International Institute for Land Reclamation and Improvement, Wageningen, The Netherlands.

Hand vs. Mechanical Feeding of Layers, by W. E. Matson and C. H. Zuroske, Bulletin 579, February 1958, Washington Agricultural Experiment Stations, Institute of Agricultural Sciences, State College of Washington, Pullman, Wash.

Materials Handling on Poultry and Dairy Farms, by W. E. Matson, E. L. Preedy and C. H. Zuroske, Department of Agricultural Engineering State College of Washington, Pullman, Wash.

Farmstead Lighting, by D. W. Works, Farm Electrification Leaflet No. 43, September 1958, University of Idaho, College of Agriculture, Moscow, Ida.

Comparing Cage and Floor Methods of Egg Production, by Donald G. Paris, Wilmer Browning and J. E. Humphrey, Circular 560, University of Kentucky, Cooperative Extension Service, Lexington, Ky.

Harvesting Machinery for Hay and Silage, by A. I. Magee, Publication 885, Experimental Farms Service, Canada Department of Agriculture, Ottawa, Ontario.

(Continued on page 111)

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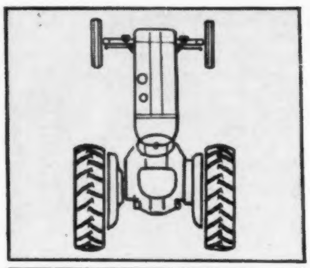

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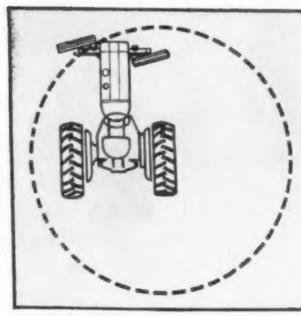

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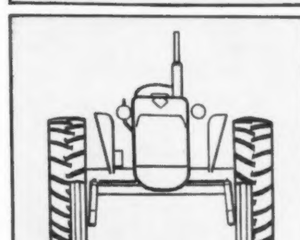

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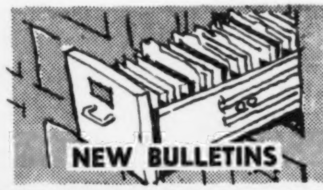

The following bulletins have been released recently. Copies may be obtained by writing to author or institution listed with each.

Concentrate Metering for Dairy Cows in Stanchions and Milking Parlors, by E. C. Schneider. Bulletin 609, September 1958. Agricultural Experiment Station, University of Vermont and State Agricultural College, Burlington, Vt.

Ventilating Poultry Houses with Fans, Extension Bulletin 529, June 1958. Extension Service, State College of Washington, Pullman, Wash.

Agricultural and Horticultural Engineering Abstracts, Vol. IX, No. 3, 1958, Abstracts 928-1316, National Institute of Agricultural Engineering, Wrest Park, Silsoe, Bedfordshire, England.

Farm Power Sprayers, PNW Bulletin No. 23, September 1958, University of Idaho Agricultural Extension Service, Moscow, Ida.

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(Continued on page 111)

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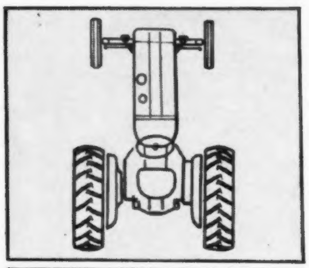

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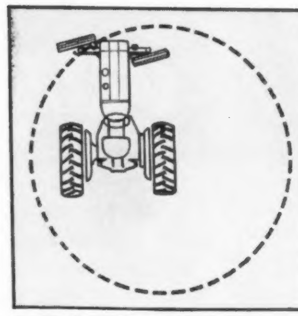

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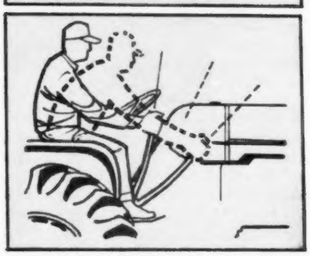

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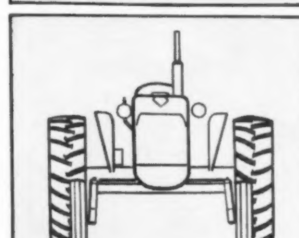

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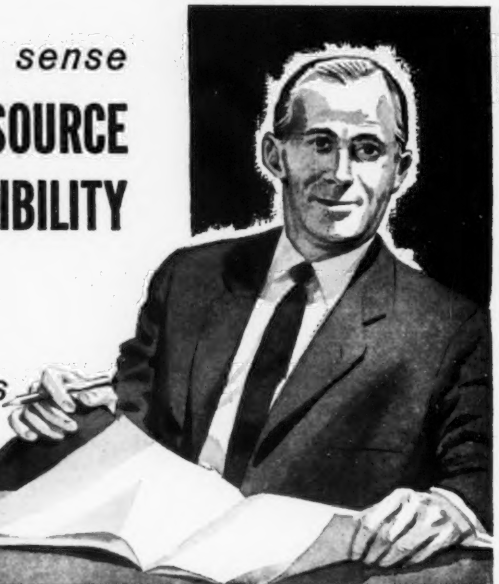

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MANUFACTURERS' LITERATURE

Literature listed below may be obtained by writing the manufacturer.

Newly Added Implements

Allis-Chalmers Mfg. Co. — Two leaflets describing implements added to the company's line of farm equipment. Leaflet TL-1837 describes the 400-series cultivators designed for the Allis-Chalmers D-14 and D-17 tractors. Brochure TL-1879 tells about the Model K offset disc harrow.

Poultry Housing Reference

Stran-Steel Corp., Detroit 29, Mich.—A 6-page bulletin which details the functional requirements of poultry housing as related to environmental control, sanitation, space requirements, equipment, and labor saving operations. The Strain-Steel laying house design is described and illustrated. A section on proper egg handling and cost of modern laying houses is included.

Oilless Bearings

Wakefield Bearing Corp., Wakefield, Mass. — A 72-page catalog on oilless and self-lubricating bearings, bushings and machine parts, including complete details about the company's alloys and their recommended uses, a section on properties of powdered metal compositions, tables illustrating standard sizes of bearings available from tools already on hand.

Backfiller Features New Clutch

The Cleveland Trencher Co., 20100 St. Clair Ave., Cleveland 17, Ohio — A 6-page folder describing the company's new 190 pipeline backfiller with its new water-cooled throw-out clutch. The clutch reportedly prevents overheating, provides accurate continuous casting control, maintains proper clutch adjustment and adds to the work life of clutch components.

Revised Engine Bulletins

Hercules Motors Corp., Canton 2, Ohio — Five revised two-page bulletins describing Hercules six-cylinder L-head gasoline engines (Models RXC, HXE, JXLD, QXLD, and WXLC-3). Each bulletin includes photos of the subject engine together with basic installation diagram, general data, power chart and detailed specifications.

Hydraulic Hose and Tube Assemblies

Eastman Mfg. Co., Manitowoc, Wis. — Technical Bulletin 100, describing medium-pressure Eastman hydraulic hose and tube assemblies. Contains 36 pages devoted to Eastman features found in medium to low-pressure hydraulic hose and tube assemblies with accurate dimensional drawings and complete tables of available sizes.

Caterpillar Products

Caterpillar Tractor Co. — A 24-page catalog entitled, Caterpillar Products, illustrating the complete line of Caterpillar tractors, diesel engines, motor graders, and earthmoving equipment. It also includes nomenclature and specifications of all products.

Fir Plywood

Douglas Fir Plywood Assn., 1119 A. St., Tacoma 2, Wash.—An 8-page catalog including data on bending radii, deflection, acoustical properties and other physical characteristics of fir plywood; a chart of the characteristics and proper use of each grade of material, and recommendations for cutting, drilling, fastening, gluing, nailing and finishing. *(Continued on page 108)*

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. . . Manufacturers' Literature

(Continued from page 106)

Rims Catalog

The Goodyear Tire & Rubber Co., Akron 6, Ohio — A 94-page, multi-purpose catalog of information and engineering data on rims, wheels, tools and rim accessories. Text includes information and pictures on rim research, step by step procedure for mounting and demounting rims, and operating instructions for using hydraulic tools.

Soil Moisture Meter

Soiltest, Inc., 4711 W. North Ave., Chicago 39, Ill. — A 6-page folder on the Bouyoucos soil moisture meter, explaining what the meter is, how it works, and what it means to users. The basic purpose of the meter is to indicate rapidly and accurately the amount of moisture available in a given section of soil.

Helical Screw Pump Catalog

Continental Pump Co., 1027 S. Vandeventer Ave., St. Louis 10, Mo. — An 8-page catalog describing its line of utility pumps, all of which incorporate the helical-screw principle. These pumps have no vanes, turbines or impellers. Only one moving part turning in a tough rubber stator provides positive displacement. The pumps are available in cast iron, cast aluminum, stainless steel and molded bakelite bodies with oil-resistant stators and stainless steel and bakelite rotors.

Milking System Plan Book

Babson Bros. 2843 W. 19th St., Chicago 23, Ill. — A 32-page plan book on parlor milking and loose housing tells how to save hundreds of miles lugging milk and feed with a milking parlor, how to plan efficient loose housing, etc. The book contains complete and up-to-date collections of pictures, drawings and data on parlor milking. The authors toured colleges, experiment stations, and successful parlor installations in varying climates of the western hemisphere and leading dairy authorities, farmers and manufacturers were consulted in preparing the new plan book.

Oscillating Conveyors

Link-Belt Co., Prudential Plaza, Chicago 1, Ill. — A 24-page book (No. 2744) describes the company's complete line of conveyors ranging from the lightest to the heaviest capacities—25 to 350 tph. Product information on trough widths, depths, section lengths, accessories and selection and application data are included.

Chain Catalog

Acme Chain Corp., 821 Main St., Holyoke, Mass. — A new 98-page catalog featuring a complete line of roller chains, sprockets, conveyor chain attachments, plus valuable engineering formulas and installations.

Backhoe-Loader

J. I. Case Co., Racine Wis. — A 8-page bulletin (CUS-110) describing the 42-hp Case utility model 310B wheel-mounted backhoe-loader. The booklet presents 35 operating characteristics of the "matched" trenching-loading machine, together with pertinent mechanical details of the equipment.

Properties of Ductile Irons

International Nickel Co., Inc., 67 Wall St., New York 5, N. Y. — A 28-page booklet containing the full story of the engineering properties of "Ni-Resist" ductile irons, including tables and graphs explaining mechanical and physical properties, erosion and corrosion resistance, and high-temperature strength.

Power Lubrication Systems

Lincoln Engineering Co., 5702-6 Natural Bridge Ave., St. Louis 20, Mo. — A 32-page catalog (No. 81) describing the company's complete line of lubricant application equipment, fittings and accessories, including descriptions of completely automatic centralized systems, semi-automatic and manual methods of lubricating machines. Includes also such fittings and accessories as air couplers, hose, filters, air gages, valves and pressure switches.

Rigid Plastic Pipe

Carlon Products Corp., P.O. Box 133, Aurora, Ohio — A 6 page illustrated bulletin (HT-100) describing the company's advanced new rigid plastic pipe, for operation at high temperatures and pressures, and suitable for sprinkler systems.

Ground Current Conduction

Aronson Machine Co., Arcade, N. Y. — A 13-page booklet for persons interested in the science of welding, explaining the importance of ground current conduction pertaining to welding positioners.

Bulk Milk Cooler Bulletin

The Pfaudler Co., 1084 West Ave., Rochester 3, N. Y. — A 6-page bulletin describing the features of the "Lo-Vat" bulk milk farm cooler. Requests should be made for bulletin 974.

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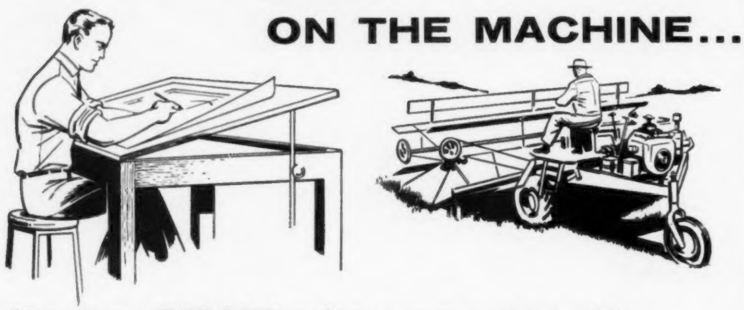

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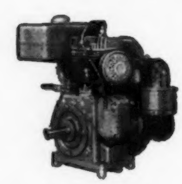
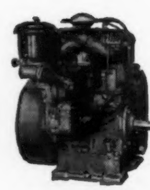
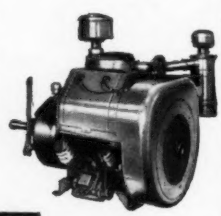


4-cycle single cyl., 3 to 12½ hp.



2-cylinder models 10 to 18 hp.



V-type 4-cylinder 15 to 56 hp.

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...Technical Paper Abstracts

(Continued from page 93)

provides structural support for the litter) and exhausted from the house through a centrifugal blower. The experiment was made to investigate a solution to the problem of dust clogging of heat exchangers on refrigeration equipment used to control the environment of animal and poultry shelters. According to results of the tests, air can be moved through 8 in. of fine litter and chopped corn cobs at a rate of 1 to 2 cfm per sq ft of litter at a static pressure drop across the litter of 1-in. water or less; air coming through litter in this way is clean enough to be passed over heat exchangers indefinitely without further filtering; air passing through the litter keeps it considerably drier than the same amount of air passed over the litter; the space above the litter smells fresher, is drier, is draft-free, but dusts up more quickly; the birds do not appear to be affected adversely nor the management problems aggravated by this ventilation system. Results also showed that air coming from under the litter during hot weather is up to 10 F cooler than atmospheric temperature and would therefore be an excellent heat sink for the operation of a refrigeration unit.

Spray Characteristics of Water from Three Converging Sprinkler Nozzles, by John M. Langa and John R. Davis, respectively, irrigation technician, Hawaiian Commercial and Sugar Co., Ltd., Puunene, Maui, and associate irrigation engineer, department of irrigation, University of California, Davis. Paper presented at the Winter Meeting of the ASAE in Chicago, December 1958, on a program arranged by the Soil and Water Division. Paper No. **58-514.**

Tests summarized in this manuscript were conducted on a system of three converging sprinkler nozzles to determine the effects of the geometry of the nozzles on the resulting water distribution patterns. Variables included in the study were: The angle of impingement of the three jets with respect to the main axis, the inclination of the main axis with respect to a horizontal plane, nozzle pressure, and the geometric arrangement of the three nozzles. Tests of a conventional single-nozzle non-rotating sprinkler were included for purposes of comparison. The results of this study show that almost any type of distribution pattern could be obtained by varying the geometry of the nozzle system. Most of these distribution patterns resulted in more uniform distribution of water; but at the same time, the use of three impinging jets decreased the wetted radius. The latter effect is offset by the improved distribution, which permits a much greater sprinkler spacing; thus reducing the number of sprinklers required for any given system.

The Griefswalder Pipe-Laying Machine and its Operation, by H. Janert, translated by C. Busch and L. Boersma. Special Report No. 79, Eastern Soil and Water Conservation Research Division, Agricultural Research Service, United States Department of Agriculture, in cooperation with Cornell Agricultural Experiment Station, Ithaca, N. Y. Paper No. **58-340.**

As a result of its unusual performance, the pipe-laying machine described in this paper received acclaim at a field demonstration of newly developed drainage machines, held in Leipzig, Germany, in 1954. Construction of an experimental series has been started and if these prove satisfactory after thorough testing under the widest range of soil conditions, then line production will be started. The machine, called the Griefswalder Pipe-Laying Machine, is meant for completely mechanized construction of pipe lines in the soil, both for the purposes of drainage and of sub-irrigation and particularly for combined installations. The paper outlines the operation of the machine; the construction of the pipe, which is done behind the digging plane by heat deformation of a prepared plastic sheet fed into a forming guide attached inside the lower portion of the plane; performance requirements; the range of application of the machine, and construction of the pipe-laying machine. It also describes the pipe-forming mechanism, backfilling of the ditch, control of the pipe-forming process, material used for machine installation of pipe lines in the soil, and additional equipment. Also included in the paper is technical data for the pipe-laying machine as well as cost calculations.

Conditioning, Handling and Storing Seed Cotton Prior to Ginning, by James A. Luscombe, engineer-in-charge, Southeast Cotton Ginning Research Laboratory, Clemson, S. C. Paper presented at the Winter Meeting of ASAE in Chicago, December 1958, on a program arranged by the Electric Power and Processing Division. Paper No. **58-818.**

The scope of this paper is limited to that area of research in mechanization of cotton production which includes the movement of seed cotton from the harvested field to the ginning point, preservation of the inherent quality of the seed cotton during the interim of movement and the preparation of the seed cotton for storage or ginning. Also discussed is the influence of custom and tradition on development of conditioning, handling and storage systems. The attributes of seed cotton for safe storage or optimum ginning are given as are the effects of ambient conditions on these attributes. The problem of conditioning, handling and storing the national cotton crop is outlined. A summary is made of results of previous research by ARS, AERD. Requirements of a theoretical system are discussed and current research is described. A list of references on the problem is included.

Some Sanitary Engineering Problems Relating to Water Management in Agriculture, by Ralph H. Holtje, acting chief, Water Pollution Control Section, Water Supply and Water Pollution Control Program, U.S. Public Health Service, U.S. Department of Health, Education, and Welfare, Washington, D. C. Paper presented at the Winter Meeting of ASAE in Chicago, December 1958, on a program arranged by the Soil and Water Division. Paper No. **58-517.**

The author of this manuscript describes common problems of the sanitary and agricultural engineering disciplines as centering as much or more on water quality as on water quantity. The sanitary engineer, he says, hopes to increase the amount of usable water by further reducing the serious water pollution problems created by sewage, industrial wastes, and such substances as soil and pesticides. He discusses the repeated use, treatment, and reuse of water, and the use of soil for sewage and waste disposal. After describing the system by which the interests of federal agencies are coordinated in developing comprehensive water resources programs, a plea is made to state and other governmental units to monitor the coming head-on clash among water users.

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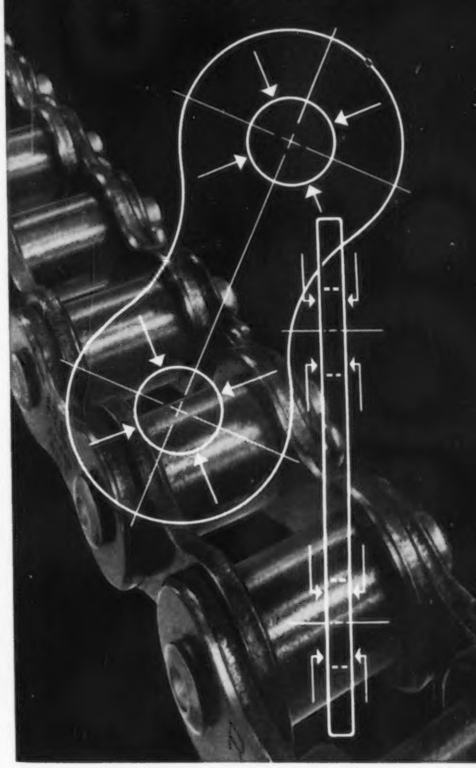

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The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Boston, Jack A.—Midwest sales rep., Telepix-Anderson Inc., 6620 W. Diversey, Chicago 34, Ill.

Brcic, Josip — Private docent and teacher of agr. eng., University of Zagreb, Yugoslavia. (Mail) Zagreb, Branimirova 5, Yugoslavia

Critchfield, John H.—Superintendent, maintenance and mill operation, Ralston Purina Co., P.O. Box 29, Wilson, N. C.

Good, William J. Jr.—Farm service dir., Independent Nail and Packing Co., P.O. Box 157, Bridgewater, Mass.

Grise, James W. — Farm service advisor, Green River Rural Electric Co-operative Corp. (Mail) R.R. 2, Owensboro, Ky.

Halls, Lawrence M.—Engr.-draftsman, New Ulm Mfg. Co., 1007 N. Minnesota St., New Ulm, Minn.

Hard, Leon E.—Agr. engr. trainee, J. I. Case Co. (Mail) c/o Warren G. Hard, The White City Farm, 488 N. Briggs Rd., R.R. 1, Quincy, Mich.

Hart, Luther Jr.—District rep., F. E. Myers and Bro. Co., Box 232 Altamonte Springs, Fla.

Durana, Hernando A. — Principal engr., Olarte, Ospina, Arias and Payan (Olap) (Mail) Calle 72 No. 13-66, Bogota, Colombia, South America

Herschberger, Eli D. — Owner-operator, Herschberger Drain Co. (Mail) R.R. 2, Box 36, Arthur, Ill.

Jacobson, Robert R.—Special projects engr., Cargill, Inc., 200 Grain Exchange, Minneapolis 15, Minn.

King, Donald R.—Group supervisor, Vickers, Inc. (Mail) 2687 Heathfield Rd., Birmingham, Mich.

Lee, Arthur E.—Gen. mgr., marketing and economic res., Massey-Ferguson, Ltd., 915 King St. W. Toronto 3, Ontario, Canada

Martinuik, Martin—Managing Dir., North West Seeds, Ltd., Box 66, Dawson Creek, B. C., Canada

Mohamed, Wan D.—Agr. officer, ext. service, Dept. of Agr., Taiping, Perak, Malaya

Moore, Jack R.—Head, industrial arts dept., Shaw High School. (Mail) 29041 W. Willowick Dr., Willowick, Ohio

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Rowe, Lloyd C.—(SCS) USDA, Post Office Bldg., Augusta, Maine

Schikaneder, Karl A.—Test technician, New Holland Machine Co., Div. Sperry Rand Corp. (Mail) 327 E. Main, Ephrata, Pa.

Schoof, Russell R.—Asst. engr., Div. of Water Resources, State Board of Agr. (Mail) 209 North Pine, Stockton, Calif.

Sousek, Eugene A. — Chief draftsman, Fox River Tractor Co. (Mail) 506 N. Douglas St., Appleton, Wis.

Thurmond, William—Agr. engr. (SCS) Box 512, Cookeville, Tenn.

Transfer of Membership

Bowden, Lee C.—Designer, room air conditioner dept., General Electric Co. (Mail) 1862 Douglass Blvd., Louisville 5, Ky. (Associate Member to Member)

Gustafson, M. Lee—Project engr., res. and dev., Farmhand Div., Superior Separator Co. (Mail) 7626 Grand Ave., S. Minneapolis 23, Minn. (Associate Member to Member)

Howard, William J.—Res. engr., Tractor and Implement Div., Ford Motor Co. (Mail) 4625 Holmes Dr., Warren, Mich. (Associate Member to Member)

Jahr, Everett C.—Agr. engr., (SCS) USDA. (Mail) 23 Nacional St., Salinas, Calif. (Associate Member to Member)

Kay, Bennett M.—Power use advisor, Northeast Oklahoma Electric Cooperative, Inc., Vinita, Okla. (Affiliate to Member)

Kolega, John J.—Chairman, agr. eng. dept., University of New Hampshire, Durham, N. H. (Associate Member to Member)

Sanders, George S.—Gen. mgr., des. and consulting directing res., Agricultural Aviation Engineering Co., Inc., 1028 W. Evelyn Ave., Sunnyvale, Calif. (Associate Member to Member)

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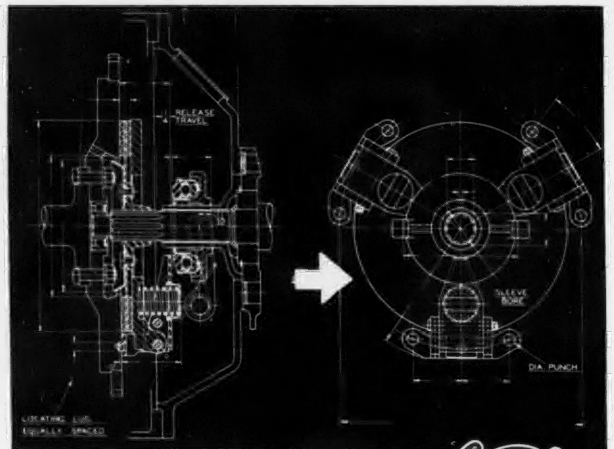
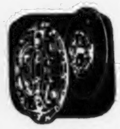
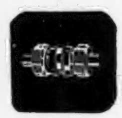
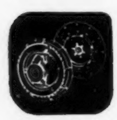
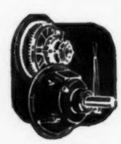


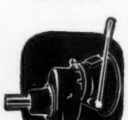

Small Spring Loaded


Heavy Duty Spring Loaded


Oil or Dry Multiple Disc


Heavy Duty Over Center


Power Take-Offs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CLUTCHES

PERSONNEL SERVICE BULLETIN

NOTE: In this bulletin, the following listings current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency or registration as a professional engineer. Items published herein are summaries of mimeographed listings carried in the Personnel Service, copies of which will be furnished on request. To be listed in this Bulletin, request form for Personnel Service listing.

POSITIONS OPEN—1958—AUGUST—O-276-830. SEPTEMBER—O-308-831. OCTOBER—O-321-832. NOVEMBER—O-330-834, 331-835, 343-837, 344-838. DECEMBER—O-352-839, 353-840, 349-841, 349-842, 356-843, 362-844. 1959 — JANUARY—O-418-845.

POSITIONS WANTED—1958—AUGUST—W-258-38, 236-39, 260-40, 261-41, 242-42, 271-43, 286-44, 287-46. SEPTEMBER—W-279-47, 297-48, 248-50. OCTOBER — W-314-52, 315-53. NOVEMBER—W-332-55, 324-56, 339-59, 318-60. DECEMBER—W-347-61, 345-62, 346-63, 358-64, 363-65, 364-66. 1959—JANUARY—W-355-67. 383-68, 411-69, 412-70, 406-71, 419-72, 422-73.

NEW POSITIONS OPEN

DESIGN ENGINEER with specialized experience in backhoe design for work with manufacturer on design and development of a unit-mounted backhoe and related equipment. Location Illinois, greater Chicago area. Age, under 55. Degree in agricultural, mechanical, or civil engineering, with emphasis on mechanical design and development. Experience 3 or more years in backhoe design, in addition to related experience with tractor-mounted machinery. Personable, expressive, creative, and amiable man required. Will work closely with one or two other engineers. Excellent opportunity for experience, growth, and advancement with a new firm with top financial backing. Salary commensurate with ability, $10,000 minimum starting. O-13-901

NEW POSITIONS WANTED

AGRICULTURAL EDUCATIONAL SPECIALIST with experience in teaching farm shop and farm machinery courses, for extension, teaching or research in power and machinery with public service agency or foundation, any location. Married. Age 35. No disability. BS and MS in agricultural education, Purdue University, 1951 and 1957. Experience as agriculturalist in Africa, teaching vocational agriculture and farming in United States, and agricultural engineering advisor in Burma. Available in June. Salary open. W-9-1.

AGRICULTURAL ENGINEER for teaching, research, extension, design or promotional work in farm structures with public agency, trade association, or consultant. Prefer West or Midwest. Married. Age 42. No disability. BSA, 1943, North Dakota; BSCE, 1954, University of Wisconsin; MSAE, 1957, University of California. Experience as farm structures engineer, 8 years; graduate assistant 2 years; assistant professor of farm structures 3 years. Available July 1, Salary open. W-17-2

AGRICULTURAL ENGINEER for teaching or research, soil and water field, with college, anywhere in United States. Interested in graduate teaching assistantship and work for advanced degree. Married. Age 30. No disability. BSAE, 1943, Iowa State College, with major in farm structures. Experience teaching farm machinery 3 years, American University of Beirut. Experimental engineer 5 years with farm equipment manufacturer. ICA contract assignment in Iraq 5 years, teaching farm structures and farm machinery. Available July 1. Salary open. W-22-3

ADMINISTRATOR in farm equipment field for sales or management with manufacturer or distributor, preferably in Western USA or Canada. Married. Age 35. No disability. BSA, 1948, University of British Columbia. Sales and service training 6 months. Service parts distribution 6 months. Sales and sales management over 3 years. Management of distributorships, 6 years. Manager of logging contracting firm one year. RCAF pilot 2 years. Available on 30 days notice. Salary $9,000. W123-4

AGRICULTURAL ENGINEER for design, development, research, sales, or writing, any branch of agricultural engineering, industry or public service, Southeast location preferred but will consider any. Willing to travel. Married. Age 25. No disability. BSAE, 1955, Clemson Agricultural College. Short period of engineering work with large aircraft manufacturer. Military experience in photography, aircraft maintenance, and aircraft pilot duty. Army fixed and rotary-wing pilot experience with instrument and instructor ratings, all in light business-type aircraft. Available July 1. Salary open W-20-5

. . . New Bulletins

(Continued from page 104)

Reclamation and Melioration, abstracts of reports on land reclamation, irrigation and drainage in Japan, No. 2 (December 1957) and No. 3 (July 1958), The Agricultural Engineering Society of Japan, Office of Faculty of Agriculture, University of Tokyo, Tokyo, Japan.

Relation of Drying Air Temperature, Time, and Air Flow Rate to the Nutritive Value of Field-Shelled Corn, by C. A. Cabell, R. E. Davis and R. A. Saul, ARS 44-41, November 1958, AERD, Agriculture Research Service, United States Department of Agriculture, Beltsville, Md.

Nailing of Plywood Sheathing with "Hi-Load" Nails, by E. George Stern, Bulletin No. 35, May 1958, Virginia Polytechnic Institute, Wood Research Laboratory, Blacksburg, Va.

Poultry Houses with Scissor-Type Nailed Trussed Rafters, by E. George Stern, Bulletin No. 34, April 1958, Virginia Polytechnic Institute, Wood Research Laboratory, Blacksburg, Va.

France and Agricultural Machinization, October 1958. Write to 45, Rue De Lisbonne, Paris 8e, France.

The following list of bulletins have been received from the Agricultural Engineering Dept., Canterbury Agricultural College, Lincoln, New Zealand:

Development of a Continuous Acting Ditch Cleaning Machine, by D. L. King, Research Publication No. 49.

Canterbury Agricultural College Baled Silage, by D. L. King.

Equipment for Spray Irrigation, by A. W. Riddolls, No. 330, January 1957.

Equipment for the Renovation of Grasslands, by G. G. Lindsay, No. 321, April 1956.

Silage Making Machinery, by G. G. Lindsay, Bulletin No. 325, August 1956.

Application of Irrigation Water by Surface Methods, by A. W. Riddolls, Bulletin No. 306, January 1955.

Fundamentals of Irrigation, by A. W. Riddolls, Bulletin No. 300, July 1954.

Tile Drainage, by A. W. Riddolls, Bulletin No. 297, April 1954.

Interpretation of Tractor Test Results, by D. L. King, Bulletin No. 276, July 1952.

"Taking Levels" on the Farm, by A. W. Riddolls, Bulletin No. 266, September 1951.

Mole Drainage, by A. W. Riddolls, Bulletin No. 264, July 1951.

Power from Your Tractor, by R. H. Cochrane, Bulletin No. 255, October 1950.

Pumping for Surface Irrigation, by A. W. Riddolls, Bulletin No. 254, September 1950.

Torque Reaction and Tractor Safety, by R. H. Cochrane, Bulletin No. 250, May 1950.

More About Tractors, by R. H. Cochrane, Bulletin No. 246, January 1950.

Drawbar Pull and Tractor Safety, by R. H. Cochrane, Bulletin No. 240, July 1949.

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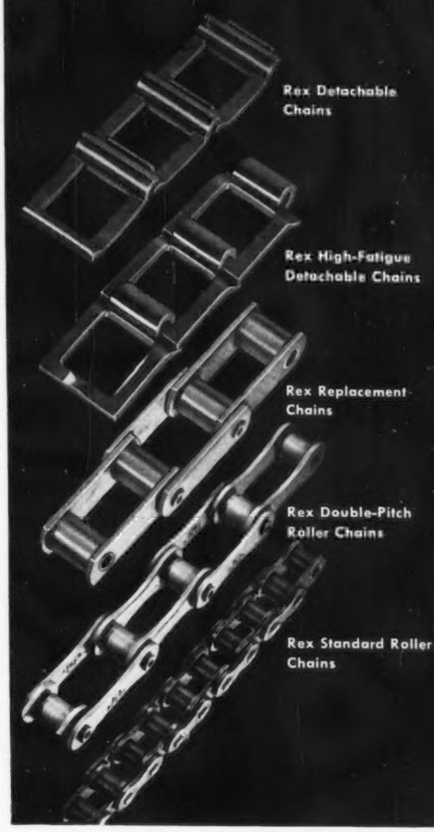

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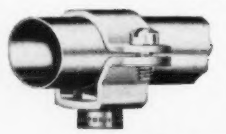

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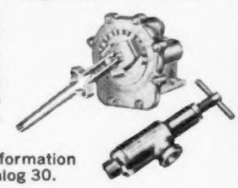

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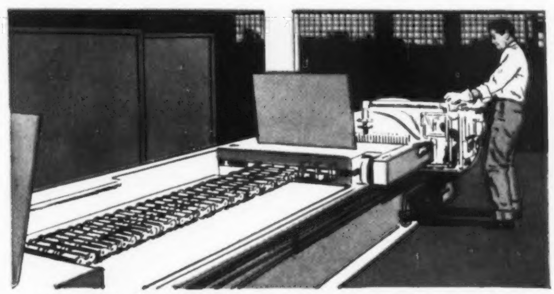

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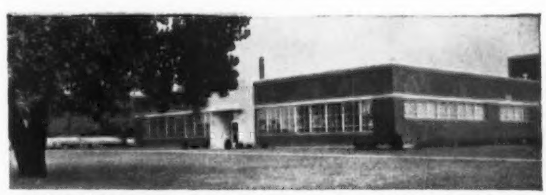

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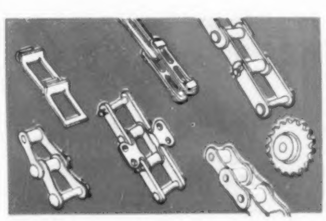

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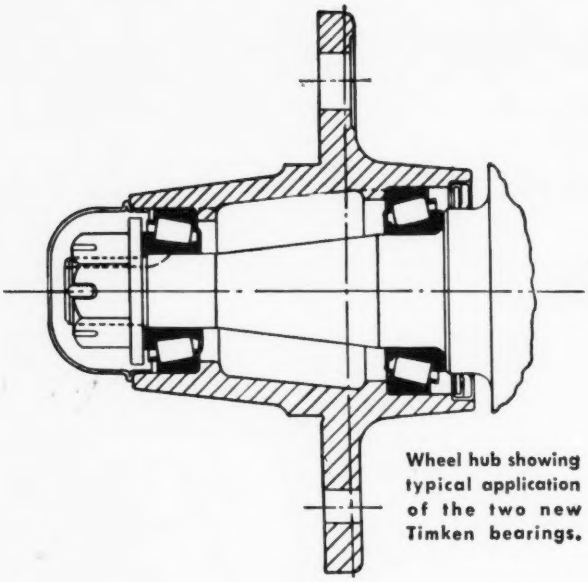
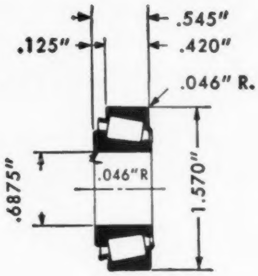


Wheel hub showing typical application of the two new Timken bearings.



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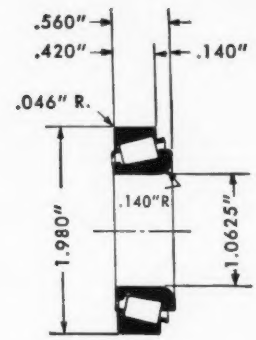

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